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A RECORD OF PROGRESS IN

Science, Mechanic Arts and Agriculture.

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INTRODUCTORY.

The increasing taste for scientific study which nowadays manifests itself among all classes of readers, and the evident impossibility of any considerable number of them being able to spare the time necessary to examine the scores of journals and magazines devoted to its special branches and subjects, have given rise to the belief that a periodical consisting of a careful resumé of the most important inventions, discoveries and treatises of eminent, practical workers in the various departments of science and industry would be a convenience and of service to such persons, and might meet with sufficient encouragement to make it a success.

With this idea in view the first number of "THE WESTERN REVIEW OF SCIENCE AND INDUSTRY" is offered to the public, and it is hoped that the foundation is thus laid for a publication which will long continue the exponent of the progress of practical knowledge and industry for this portion of the country.

As announced in our prospectus, this periodical will have for its object the popularizing of science, and will be devoted to the interests of the artisan, the mechanic, the farmer and the household, as well as of the more scientific reader. Very little space will be given to editorial speculations, or to advocating the theories of any man or class of writers, but it will rather be our aim to fill the pages of the "REVIEW" with useful and practical information upon the subjects of mechanics and engineering, applied

chemistry and metallurgy, geology, meteorology, archæology, agriculture and horticulture, materia medica, therapeutics and hygiene, domestic economy and scientific bibliography, derived from the best and most authentic sources, systematically arranged and presented in a plain and simple manner, so as to give actual and practical results in a form adapted to the wants and tastes of all classes of readers.

It is believed that such a journal will enable amateurs to keep pace in a general way with the advancement and progress made in most if not all of the departments of science, and that its practical suggestions and selections will be found of decided value to working people of all classes, whether in the laboratory, the workshop, the field or the dwelling house; and it is hoped that it may meet with a support commensurate with its merits, in which event no efforts will be spared to make it equal to any periodical of the kind in the country.

ARCHÆOLOGY.

The recent discoveries made by General Di Cesnola, in Cyprus, and Dr. Schliemann, in Asia Minor and Mycenæ, are attracting so much attention on account of their wonderful results and all absorbing interest, that we have concluded, at the risk of seeming to be behind the times, to give a summary of all that both have done up to the present time.

We also call attention to the very interesting contribution made by Judge West to the literature of mound building, in his report to the Kansas City Academy of Science of the explorations made by himself and his associates among the mounds of Clay County, Missouri, last fall.

DR. SCHLIEMANN'S DISCOVERIES AT MYCENÆ.

Dr. Henry Schliemann, who is now about fifty years of age, is described as being five feet nine inches in height, rather stout, with full, round, unshaven face, and wearing the air of and clothes of a successful merchant. He seems to have commenced life as as an employé in a German mercantile house, where he learned Italian from a fellow clerk, bought a grammar and taught himself Greek; became passionately fond of Homer and other ancient Greek authors; afterwards learned Russian and went to Russia and engaged in business, where he made a handsome fortune, which he subsequently increased to a princely sum in California.

Having always opposed the "Wolfian hypothesis" that the Homeric poems are simply made up of some sixteen or more rhapsodic songs, composed independently by a number of poets, transmitted from remote periods by

memory and finally consolidated into a not very harmonious whole, Dr. Schliemann, upon finding himself in independent circumstances and possessed of a wife who shared his enthusiasm, determined by his own explorations, guided by Homer's own descriptions and those of some later writers, such as Pausanias and Herodotus, to prove that Homer himself was a real personage, and that his poems were based upon historical facts.

Commencing his excavations in Asia Minor, some three or four years ago, under a firman from the Turkish Government, he soon startled the scientific world by claiming to have discovered the remains of ancient Troy upon the heights now called Hassirlik. While this claim was never fully admitted by archæologists, he certainly made some most interesting and valuable discoveries, disinterring successively cities superimposed upon cities, and exhuming from their hidden recesses relics of ancient art extremely important in illustrating the customs and civilization of Greece in those early times. Before he had concluded his explorations and excavations, however, his firman from the Turkish Government expired, and official jealousy prevented his procuring its renewal. The results of his researches having been published, as well as a series of photographic pictures representing the treasures found by him, known as the Hassirlik Album, it is not necessary to give an extended account of them here.

Undiscouraged by his disappointment in Asia Minor, he obtained permission from the Greek Government, a few months ago, to make excavations at the site of Mycenæ, the town of Agamemnon, "King of Men," and the principal city of Greece at the time of the Trojan war. The work was commenced last spring, but until within the past few months attracted very little attention. Now, however, Dr. Schliemann's discoveries are regarded as among the most important of the nineteenth century, and, by many archæologists, as fully corroborative of his position that Homer was a reality, and his poems at least historical, if not exact history. Others still doubt, and await further developments and more minute and precise descriptions, accompanied by photographs of the objects of gold and bronze discovered, before giving their assent to the truthfulness and credibility of Dr. Schliemann's amazing story. At all events, he has discovered the tomb of a royal family, and even if it should prove not to be that of Agamemnon, its discovery throws much light upon the history, art and daily life of the ancient Greeks, while the remarkable agreement between Homer's description of their arms, utensils and accouterments and those actually found tends to shatter the "Wolfian hypothesis," and place the blind poet of Argos among the most reliable authors of the past.

The first extended report of these wonderful discoveries reached this country last fall and have been followed by several letters from Dr. Schliemann himself, the last of which was received by the London *Times*, in the latter part of December, 1876.

"In the northern corner of the Plain of Argos, at the base of two rocky mountains, one of which is 2,500 feet above the sea level, and whose summit

is crowned by a small church dedicated to the Prophet Elias, is situated the celebrated Acropolis of Mycenæ. It stands on a triangular shaped rock 132 feet in height and about 1,200 feet square, and is surrounded by cyclopean walls from thirteen to forty feet in height. These walls are of three different styles of architecture, and were doubtless built in three different eras. One part is, like the walls of Tyrius, composed of large stones built upon small ones; another part composed of polygonal stones beautifully joined. The third style, situated near the Gate of Lions, is composed of large square blocks of stone built in horizontal lines. The lower city was situated to the south and southwest of the Acropolis, as is seen by the remains of the cyclopean walls, houses and a bridge, all cyclopean; also nine treasure houses, and by the fragments of beautifully painted ancient clay vases, with which the ground is literally covered. The position of the town being principally on precipitous hills, the accumulation of earth is but small; and does not exceed eighteen inches in depth.

Six of the treasure houses are shaped like furnaces, and are so called by the inhabitants to-day. Five of them, it appears, were excavated in ancient times; but the result was not, it is supposed, encouraging, as no attempt was ever made to open a sixth, which was above ground, and could easily have been excavated in a single day by a few workmen. Other two of these treasure houses were conical in form, like the well-known one of Atreus. One, situated near the Gate of Lions, is small, and was, it appears, excavated by the ancients. The one now being excavated seems to be nearly as large as the treasure house of Atreus. Seven or eight workmen were employed for about a fortnight before they succeeded in bringing to light the upper part of the triangular opening into it, and about 1,000 cubic feet of earth had been removed before beginning to excavate the treasure house itself. Twelve men were engaged for quite a fortnight in opening the entrance of the Acropolis through the Gate of Lions. It was blocked up by huge stones, which, it appears, were thrown down on to the Argives when they were besieging the Acropolis, 468 years B. C.. Such, at least, is the opinion of Dr. Schliemann. At once to the left, after entering the gate, a small room has been found, the roof of which is formed of a single large slab. It is so low one can hardly stand upright in it; though so small, it must have been used by the doorkeeper. No ancient author affirms that the ancient City of Mycenæ was inhabited after its capture by the Argives, when the inhabitants were driven away; but Dr. Schliemann is convinced that it was again peopled, and that there was a new city existing for a long time, probably for more than two centuries, because the surface of the ground to a thickness of three feet is full of the remains of a Greek age. This repeopling took place, according to Dr. Schliemann's ideas, early in the fourth century B. C., and he thinks it was again devastated in the second century B. C. This theory is supported by the fact that many coins of the Macedonian period have been found, and by the entire absence of the coins of the Roman epoch. The City of Mycenæ had no coinage of its own. Under the comparatively modern Greek city quantities of fragments of beautifully painted ancient vases have been found, painted both inside and outside, the inside painting, from the variety of the coloring and beauty of design, frequently far surpassing that of the outside. Some of the fragments have stags painted outside, and inside figures of men and women. Perfect vases have frequently been met with having two handles and a small pipe through which the liquids were poured in and out. All these painted vases were made on a potter's wheel, except very small ones, which were made by hand. Here were found, in August, more than 200 figures of Juno, some entire, others broken. They are of baked

clay, and are formed either to represent a cow or a female with horns. Most of them are ornamented with bright red paintings, and the women are represented with full breasts, under which protrude long horns, which unite and form a semi-circle. There were also found twelve other figures of Juno, the bodies shaped like quoits, the heads uncovered and without horns; hair hanging down the back in a plait; also, some figures with heads like birds, with large eyes and hands clasped on their breasts. A doll, about five and one-half inches high, representing a very ugly old woman, probably a priestess, was also found. Glass and iron were known to the Mycenæans in very ancient times, as at a depth of ten feet a pierced glass bead and many articles of a glass-like substance, something like buttons, were found; the latter were probably used to ornament doors, etc. In iron were found two daggers and two keys of very curious construction. One of the keys, about five inches in length, has at one end a copper ring for suspension; also, two well-preserved bronze knives, one of which has part of a bone handle; and two arrows with pyramidal points, resembling some Carthagenian arrows found by Dr. Schliemann while excavating in Sicily last year; also, five finely polished stone axes and a small but thick quoit of baked clay, with a deep grove around it, in which a string was tied to hang it up by. One side of this quoit is quite smooth and many symbols of holy fire, often met with in Troy, are graved on it. In the same place hundreds of spindles, nearly all made of beautiful blue stone, without any ornament, were found.

It appears that the Mycenæans were musicians, as fragments of a finely ornamented lyre and of a flute made of bone have been found; also, fragments of a crystal vase and a wooden comb. Very often are found smooth pieces of dry clay, with painted or graven ornaments, which were probably used to decorate the inner walls of houses.

At a depth of from ten to eleven and a half feet (sometimes at six and a half feet) cyclopean houses are discovered; they are built of rough stones, without lime or earth, and stand sometimes at a depth of twenty feet on the solid rock. More remarkable here than even at Tyrius are the aqueducts. There they are cut in the natural rock, while here they are built on the ground. They are of stones, roughly hewn, and without lime. It is impossible to conceive how the water ran along without escaping through the crevices.

Still further on have been found many graves, as seen by the large slabs of limestone which mark each tomb. Some of these tablets are plain, others have anaglyphs of priceless value to the archæologist. A remarkable one has carved in the centre a warrior, lance in hand, standing on a chariot drawn by a horse, whose widely-extended legs show his great speed; the wheels of the chariot have four spokes, forming a cross; below is seen a stag pursued by a dog; on either side are very strange ornaments, having probably a symbolical meaning. On another slab there is also a warrior standing on a chariot; in his left hand he holds a broadsword, in his right a long lance, which is piercing the neck of a fantastic wild animal which is running very quickly, and much resembles the lions on the gate. The difference is that this beast has horns and his tail erect; but as the lions' heads are wanting, who knows if they were not also horned? In front of the animal stands a man with a large knife; with his left hand he holds the right horn of the beast, which partly conceals the horse in the chariot. Behind the chariot is a curious device, and another above the beast. Probably these, also, have symbolical meanings. Above the anaglyph there are exquisite ornaments, consisting of spiral lines. Each tablet is about four feet square and six inches thick.

After very minute examination of this anaglyph, Dr. Schliemann observes that the appearance of all the animals, especially the formation of the beast with horns, so much resembles the style of sculpture of the two lions that he is convinced they belong to the same period—that is to say, 1200 B. C. Probably all the treasure houses of Mycenæ and the portion of cyclopean walls on either side of the Gate of Lions, as well as the gate itself, are of the same period. Homer repeatedly calls Mycenæ the "Golden City." Its great wealth is certainly confirmed by its numerous treasure houses, and by the splendor of its architecture; but the great question arises how this city, in the most remote period of antiquity, when commerce did not exist, acquired its enormous quantities of gold. It certainly appears that the Mycenæans could only have gained their wealth by piratical expeditions to the coasts of Asia.

In the great trench, which is near the Gate of Lions, the excavators have brought to light three rows of tombs, inclosed by a slim circular wall extending to a neighboring rock. These tombs are made of limestone, and are very near each other; they are from thirteen to sixteen feet deep. By the side of them were discovered two lines of monumental tablets, of which three in one line and four in the other stand upright. One of them is divided into two parts, and has sculptured on it a man in a chariot, drawn by one horse, whose great speed is shown by the position of his legs and tail, which stands erect. Behind the chariot is the handle of a spear. By the side of the horse is a second man, standing upright, with an entirely unknown weapon in his hand. On either side of the chariot are carved in a circle regular spiral ornaments. Another sepulchral tablet is ornamented with carvings representing serpents, whose spiral coils form magnificent ornaments. In the same row of tablets there are pieces of three others. The sculptures on them represent men and horses. A little further on a roofless cyclopean house has been found. In excavating it a great quantity of ashes and thousands of pieces of antique painted vases were brought to light, as well as quantities of plumb line weights, having handles on both sides for suspension, and a small quantity of charred wheat; also numerous spindles made of blue stone. On one of the vases is a very curious painting. It represents two swans, their heads close together, delineating in a manner the Russian crown. In addition to all these above mentioned tombs, others have been discovered of a very peculiar shape, about three feet deep and from six to eight feet wide, and made of small flags. The articles found in them are pieces of vases and bones. It may be affirmed for a certainty that all the bones are those of animals, because among them are many cheek bones of swine. From the absence of other articles Dr. Schliemann conjectures that in a more remote period the tombs were pillaged and filled up again.

The discovery of tombs on the virgin soil near the Gate of Lions, on the most celebrated part of the Acropolis, where one expected to find the palace of Agamemnon, makes it clear that these tombs are those of illustrious men. Pausanias, speaking of Mycenæ, says: "Clytemnestra was buried, and Ægisthus, a little further on, outside the walls; inside, where Agamemnon and those who died with him were buried, they were not considered worthy to be interred." Of course, says Dr. Schliemann, what Pausanias says about the tombs he had not himself seen, but learned it from tradition. When he visited Mycenæ, 170 years after Christ, they had been for centuries buried under the debris of prehistoric ruins on which the Greek city had been built, and which was itself destroyed four centuries before Pausanias lived. There were also found a large piece of porphyry with splendid reliefs, representing among other things three roses; and another piece of al-

most similar stone, with beautiful serpentine ornaments, similar to those taken out of the treasury of Atreus, which are now in the British Museum.

In excavating the treasure house of Clytemnestra (so-called), near the Acropolis, many figures of Juno were found. Some have extended hands, others have them clasped on the breast. Also some female figures, with large eyes and outstretched hands. On each side of the breasts horns protrude, and, uniting, form a circle. Also male figures, with uncovered heads, ornamented by a diadem with a star. The figures have large Asiatic noses, large eyes, and Assyrian beards. Many figures of Juno, in form like a cow, are also found, decorated with paintings in red and blue. All these were found in a trench in front of treasure houses. In the Acropolis figures of Juno were found in such abundance that more than seven hundred have been collected. There also have been discovered many figures the centres of whose bodies form quoits, and represent the full moon. As Juno was at first the goddess of the moon, the horns of the cow represent the crescent moon. There are also figures with uncovered heads, bird-shaped. Others with heads much compressed, and having on them a kind of flat dish or plate, on which a cross is sometimes painted. Figures of females with cows' heads are frequently met with, but these until the present time (November 21) have been seen only on handles of vases. Curiously enough these pictures of figures with cows' heads were found in Troy on vase handles only. We have also a bone button, with thin gold covering, in the middle of which is graven a circle, with a triangle made by three long, broad knives, their handles composed of beautiful spiral lines. That gold and silver were in use is proved by the fact that a piece of porphyry has been found on both sides of which are cut fifteen different patterns of ornaments, such as earrings, brooches, etc., which ornaments, there is no doubt, were always made of gold or silver. There have also been found, at a depth of about five metres, numerous copper articles, among them five large knives, two small wheels, two lances, two battle-axes, a pair of tongs, two vases and pieces of four others. Also many pieces of agate, with pictures of animals delicately engraved on them; they have holes through them, and were probably used for necklaces. Most wonderful are the variety of the paintings on the vases. The greater part of them are painted inside and outside, the inside paintings being usually much the finer.

Up to this date (November 21) only three small inscriptions have been discovered. One is on both sides of a figure of Juno; another on an earthen figure of a cow; the third is on a small quoit. The letters, Dr. Schliemann believes, are quite unknown. There are also very curious cups, in shape like a claret glass, with sometimes only one, sometimes two handles. In no part of the Acropolis is the accumulation of earth more than eight metres. This depth is only reached near the great surrounding wall. The quarry from which the stones for the great cyclopean walls were taken has been found in the village of Charvati, half an hour's distance from the Acropolis.

The excavation of the supposed treasure house of Clytemnestra would have been finished much more quickly had it not been impeded by the huge stones which appear to have fallen in from the roof. Dr. Schliemann thinks that the inner walls of this treasure house were never ornamented by brass slabs, as were those of the treasure house of Atreus and that of Minyas, in Orchonenus. This one (at Mycenæ) is simpler, and appears much more ancient than the other two. The entrance is five metres long and eight wide; the roof consists of four slabs, each six metres in length. From some marks on the walls it appears that there was, on either side of the entrance, a square pillar, and fragments of a spiral ornament are seen on the slab over the entrance. Some divisions on the stones, forming a

triangle above the entrance, show that there must, at some time, have been a triangular anaglyph, similar to the one on the gate of the Acropolis at Mylanda. The builders left these triangular spaces above the entrances either to lessen the weight which rests on the slabs of the roof or to place there some triangular anaglyph to decorate the entrance. Among the various articles which have been found inside the treasure house itself, the most curious are some horsemen, very roughly made of baked clay. They are holding with both hands the manes of the horses. They resemble those made in earth found in Bœotia. Most of the vases are covered with the meanderings of the Greek scroll and with spiral or serpentine lines. Among the pottery found in the treasury were part of a necklace with a large bead of white glass, two beads of transparent light-blue stone, and two others of a reddish blue stone. They have each a hole through and are strung on fine copper wire.

In the Acropolis, near the gate of Lions, under the ruins of a Greek building, have been brought to light a labyrinth of cyclopean walls, forming many passages one or two meters wide. They are filled with small stones and earth. In many parts the plaster on the walls is still preserved. There have been found here three arrows, with points in shape like a small pyramid. Dr. Schliemann's opinion that the double parallel rows of large slabs form an entire wall has been found correct. The half of this row of slabs has been strengthened by a small wall built for the purpose, the other half is erected on the highest rock. It is believed that each slab marks the site of some tomb, and that the space between the parallel rows of slabs has been used, perhaps, as the place where drink offerings were presented, or to plant flowers in honor of the dead. In this space also very curious articles were discovered, such as a wooden fish, a stick handle made of green stone, with a human face coarsely carved on it. The face has a very wide nose and mouth, and wears a necklace. It is quite of an Egyptian type. Further on an image of Juno, in form like a standing cow without horns, hair dressed as a woman's, and a hole in the neck to suspend the image by. There is also a figure with two feet in place of the customary pipe, with a birds head, very large eyes, hands outstretched and wearing a necklace. The hair is marked on back of the head; the dress is colored red. Also, an uncolored doll, a male, with large eyes, a large hooked nose, no mouth, the head covered with a kind of cap like a Turkish turban. Another very original figure, with bare head, like a bird's in shape, but with two ears; hands on breast—not crossed; the head turned upward. The artist evidently intended to represent the goddess praying. There are also two daggers, two arrows of glass, and many glass beads from a necklace. Also, a small quoit, of a black glassy substance, with an ornament representing a fly, with holes on both sides for suspension.

To the south of the double row of tombs, the excavators have brought to light a large cyclopean house. It contains two rooms and four passages a metre wide; the walls still show in many parts the remains of the clay which was spread over them, as we use plaster. The largest room is five metres long by four wide. The articles found in the house proved that the inhabitants were acquainted with luxury. In one room, at a depth of six metres, has been found a ring of white onyx, having an intaglio representing two animals without horns, which at first sight appear to be deer, but, after a strict examination, it is clear that the workman intended to represent cows. Both the animals have their heads turned toward their calves, in the act of sucking. Although the workmanship is very ancient, the anatomy of the animals is splendid, quite a masterpiece of art. One wonders how such work was possible without the aid of a microscope. Round pieces of

agate, with holes through them, have been found. They are engraved with spiral ornaments representing horses; also, there is a mould of black stone, having in its six sides other moulds cut, in which were cast the black glass, conical-shaped articles, which are so frequently found; each of these small cones is ornanented with spiral lines, and is pierced for suspension. In addition to these varieties there have also been found some axes made of hard black or green stone, many spindles of blue stone, and numerous vases; among the most curious are some having two or three handles, representing crocodiles. All these vases are covered with paintings of a dark red color, representing warriors, who wear breastplates and greaves; their dogs have bristles like the porcupine or hedgehog; in their helmets they have long plumes, and from the front of the helmets projects a round horn. The warriors are always armed with circular shields, the lower part of them cut like a half moon, and with lances from which protrude Trojan figures; their faces are of a very ancient type, haveing long noses and Assyrian beards. There are also other vases, having for ornaments painted circles in which are many lines or marks, which may be letters. In the cyclopean house two brass boilers have been discovered, one of which has three feet, like a tripod.

Last week great good fortune crowned the labors of the excavators at Mycenæ. On Thursday they began to find many golden and other invaluable fragments of antiquity. Inside the inclosure, at a depth of nine metres from the surface, was discovered an inestimable archæological treasure, which excites the wonder of all. On Saturday the discoveries were still more astounding. Up to yesterday two square holes have been opened (tombs they are supposed to be). The bottoms of them are covered with pebbles, on which were found burnt bones and ashes, and on them again many golden vessels, ornaments, etc. The most important are the following: Small silver bronzed head of cow, with curved horns of pure gold, ending in points, and as thick as a good-sized finger; the mouth is gilt. This head is truly a masterpiece, and quite perfect. As, however, the face is still covered with earth and rust, it is not clear if it really is a cow. Dr. Schliemann believes it is, though other archæologists, who are also there, question it. If it is a cow it is said to be a mythological representation of Io or Juno. Up to this date more than one hundred and seventy gold buttons larger than a farthing have been found, also many bone buttons, surrounded with gold, and sixteen larger golden ones, about the size of a penny; sixteen copper two-edged swords and a gold sword-handle, beautifully worked; a small lance; a belt, probably for sword, entire, and finely wrought, length over a metre and about three inches broad. Some copper boilers have also come to light. Of infinite value and interest are three or four small square plates of gold of most exquisite workmanship, with lions engraved on them. The most beautiful of them has engraved on it Hercules struggling bravely with an enraged upright lion. It is in a good state of preservation. These plates were probably used for a necklace. There is also one silver cup and three of pure gold of great weight. One has one handle, the others two. The handles on one of them are beautifully wrought pigeons, and it is ornamented on the outside with a spirited anaglyph of stars as large as a dollar. All present were astounded when a skull covered with a piece of gold leaf was brought to light. There also were many pieces of gold leaf, with beautiful ornaments on them; a cross is frequently found depicted on them. There are two sceptres, with splendid crystal handles; some pieces of gold the size of a dollar, many of them beautifully ornamented; some gold earrings and an engraved precious stone of a reddish tint, as large as a fine almond, together with many other ornaments of

smaller value, but not a single inscription or coin. The weight of all the golden articles yet found amounts to over nineteen pounds. Their archæological value is inestimable, because Dr. Schliemann states that no golden Greek antiquities prior to the Macedonian period exist in any museum in Europe."

On November 28th, 1876, Dr. Schliemann sent the following enthusiastic dispatch to the King of Greece, announcing his discoveries.

"To His Majesty King George: With unbounded joy I announce to your Majesty that I have discovered the monuments which the tradition related by Pausanias indicates as the tombs of Agamemnon, Cassandra, Eurymedon, and their companions who were killed while feasting at a banquet by Clytemnestra and her lover Ægisthus.

"These tombs are surrounded by a double parallel circle, with tablets undoubtedly erected in honor of the victims. In these tombs I have found immense archæological treasures and numbers of articles of pure gold.

"The treasure alone is sufficient to fill a large museum, and the most splendid in the world. In succeeding ages I am sure it will attract to Greece thousands of strangers from abroad. As I am laboring simply for the love of science I waive all claim to the treasure and offer it, with intense enthusiasm, entirely to Greece.

"Sire, may these treasures, with God's blessing, become the corner stone of immense national wealth. DR. HENRI SCHLIEMANN.

"Mycenæ, November 28, 1876."

Dr. Schliemann writes, under date Mycenæ, December 2, 1876:

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"Already, while engaged in the excavation of the large fourth tomb, the results of which I have described in my last two letters, I explored the fifth and last sepulchre, which is immediately to the northwest of it, and which had been marked by the large slab, with the bas relief of two serpents, and by an unsculptured tombstone, both of which were eleven and two-thirds feet below the surface of the mount, as it was when I began the excavations. At a depth of ten feet below the tombstone, or of twenty-one feet eight inches below the former surface, I found two evidently much older unsculptured tombstones, and only three feet four inches below these I found a tomb eleven and a half feet long, nine feet eight inches broad, which had been cut out in the calcareous rock to a depth of only two feet, so that its bottom is twenty-seven feet below the former surface of the mount. In variance with the other tombs, the four inner sides of this sepulchre were not lined with any walls; but, as usual, the bottom was strewn with a layer of pebble stones. On this I found the mortal remains of only one person, who, like all the other bodies, had been burnt on the precise spot where it lay. This was proved as well by the calcined pebbles below and around the corpse as by the undisturbed masses of ashes with which it was covered, and, finally, by the marks of the funeral fire on the rock walls. Around the skull of the body, which was unfortunately too fragile to be saved, was a golden diadem, with impressed ornaments, representing in the midst two suns, the remaining space being filled up with spiral ornaments. On the right side of the body I found a lance-head, with a ring on either side; further, two small bronze swords and two long knives of the same metal; on its left was found a golden drinking cup, with one handle, the ornamentation of which represents two horizontal rows of fish-spines and one row of arrow-heads. With the swords were found many small rags of beautifully woven linen, which doubtless belonged to the sheaths of these

weapons. In the same tomb was found a six and a half inch high, hand-made, light green vase, ornamented with two rows each of three protruding humps; further, a light red vase, ornamented with black spiral lines, and with two female breasts surrounded by circles of black strokes.

"The three bodies of this tomb lay with their heads to the east and their feet to the west; all three were of gigantic proportions, and appeared to have been squeezed with force into the small space of only six feet, which was left for them between the aforesaid walls; the bones of the legs, which are nearly uninjured, are really of enormous size. Although the head of the first man was covered with a heavy golden mask, his skull crumbled away on being exposed to the air, and but few bones could be saved besides those of the legs. The same was the case with the second body, which had been plundered in antiquity. But of the third body, which lay at the north end of the tomb, the round face with its flesh had been wonderfully preserved under its ponderous golden mask; there was no vestige of hair, but both eyes were perfectly visible, also the mouth, which, by the enormous weight that had been pressing upon it, was wide open and showed thirty-two beautiful teeth. By these all the physicians who came to see the body were led to believe that the man must have died at the early age of thirty-five. The nose was entirely gone. The body having been too long for the space between the two inner walls of the tomb, the head had been pressed in such a way on the breast that the upper part of the shoulders was nearly in a horizontal line with the vertex of the head. In spite of the large golden breastplate, so little had been preserved of the breast that the inner side of the spine was visible in many places. In its squeezed and mutilated state the body measured only two feet four and a half inches from the top of the head to the beginning of the loins; the breadth of the shoulders did not exceed one foot one inch, and the breadth of the stomach one foot three inches; but the gigantic thigh bones could leave no doubt regarding the real proportions of the body. Such had been the pressure of the rubbish and stones that the body had been reduced to the thickness of one inch to one and a half inches. The color of the corpse resembled very much that of an Egyptian mummy. The front of the man was ornamented with a plain round leaf of gold, and a still larger one was lying on the right eye; I further observed a large and a small gold leaf on the breast, below the large golden breast cover."

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Dr. Schliemann resumes his narrative under date December 3d:

"The now nearly mummified body was decorated with a four foot long by one and three-fourths inch broad golden shoulder belt, which, by some cause or another, was not in its place, for it now lay across the loins of the corpse, and extended in a straight line far to the right of it; in its midst is suspended and firmly attached, a small bronze sword, on which is soldered a beautifully polished, perforated object of rock-crystal in form of a jar with two silver handles. It is pierced in its entire length by a silver pin. With it was found a small object of rock-crystal in form of a funnel, with four concave sides. To the right and left of the body lay long bronze swords; to the left was also a long bronze knife. All these weapons had probably been suspended on a belt of embroidered work, which had disappeared. The sheaths of the swords had been of wood, much debris of which remained. All the sheaths had been gilded, and had in their entire length been adorned with round buttons of gold, which showed many different sorts of magnificently engraved spiral lines. The handles of the swords were plated with gold and covered with splendid engravings. Instead of

the large wood and alabaster buttons of the handles, the sword-handles of this body seem to have had at their extremity richly ornamented golden plates, ten of which were found close to it. Each of them is three and four-fifths inches long and one and three-fifths inches broad, and every one of them represents a large cow head, with long horns and immense eyes; further, a lion pursuing a stag with such velocity that his four legs are in the same horizontal line with the body; the stag, though still running at full speed, feels that he is lost, turns his head toward his merciless pursuer and looks at him full of anguish. To the reverse side of these wonderful plates still sticks a good deal of blackish matter, perhaps a sort of lime, which may have served, I do not know how, to fasten them to the handles. Two plates must necessarily have been required for each handle. To the bronze sword on the right of the body was attached a nine and three-fifths inch long golden tassel. The massive golden mask which covered the head of this body, and which I mentioned in my last letter, is twelve and two-thirds inches long and twelve and a half inches broad. It is so thick that the enormous weight, which for ages has been pressing upon it, has made no impression on it. It shows a round face, with large eyes and a large mouth, much resembling the features of the body when first uncovered, and I feel now more convinced than ever that all the golden masks faithfully represent the features which they cover. In fact, a single glance on these splendidly-made masks must convince every one that they are real portraits and not ideal types.

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"I think it necessary to add that the metal of the Mycenæan weapons, kettles, etc., may either be pure copper or bronze, for the analysis has not yet been made.

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"My last letter was of the 7th inst., and I have continued the excavations ever since with the utmost vigor, employing constantly 125 laborers and five horse carts. In the treasury the difficulties were far greater than I anticipated, particularly as the delegate of the Greek government opposed the removal of the foundations of a Hellenic house just above the lower part of the 'dromos.' Thus I have been unable to clear the latter of the rubbish, nine feet deep, which still covers its pavement, and have only succeeded in clearing out the 13-foot long and 8-foot broad passage of the entrance, and the central part of the treasury, comprising a space of 360 square feet, around which I leave a 9-foot high and 10 foot thick border of huge stones and rubbish. As soon as the Greek government consents to the removal of the aforesaid ruins, which have not the slightest value to science, I shall at once do the remainder of the work, but certainly not sooner. The two columns, to the right and left of the entrance, were not quadrangular, as I supposed, but fluted half columns, one of which—4 feet 3 inches high and 1 foot 4 inches broad—was found in the passage near the door. At 9½ feet before the latter, the 'dromos' is shut up by a five feet high wall of square calcareous stones. The door of the treasury has the enormous height of eighteen feet five inches, and is eight feet four inches broad. On the threshold, which consists of a very fine calcareous stone, and is two feet five inches broad, I found a very thin round leaf of gold. The floor of the treasury was covered with a coating of sand and chalk, traces of which are visible in many places; it slopes toward the center, which is one foot below the threshold. There was found in the treasury a large fragment of a frieze of blue marble, with an ornamentation represent-

ing a circle and a row of fish spines; further, five blades of bronze, 5½ to 6½ inches long, and a Juno idol, of the usual form, with two horns.

"In the Acropolis I have entirely cleared out the passage south of the Lions' Gate, and brought to light the enormous threshold of the latter, which consists of a fifteen-foot long, eight-foot broad, very hard calcareous block. The ruts caused by chariot wheels, of which all guide books speak, exist in the imagination of enthusiastic travelers only, but not in reality. The different monuments which I have brought to light in close proximity to the Lions' Gate, such as the immense double parallel row of closely joined slabs, the gigantic sepulchers, etc., have, since a very remote antiquity, barred the access of chariots to the Acropolis. No doubt, the fifteen small, straight, parallel furrows, which are cut all along the threshold, have been mistaken for ruts of chariots. The opening of the gateway widens from the top downward. It is 10⅔ feet high, and the width of the door is 9½ feet at the top and 10¼ feet below. In the 15-foot long and 8-foot broad lintel, are the 6-inch deep holes for the hinges, and in the two uprights, which it covers, are four quadrangular holes for the bolts or bars. There is a 1-foot 3-inch long and 1-foot broad quadrangular hole in the midst of the threshold, where the two wings of the gate joined. The threshold further shows, on its east side, a 1-foot broad artificially cut straight furrow, and on its west side another, which forms a curve; both seem to have served as channels for the rain water, the rush of which must have been great, the threshold being lower than the rock of the passage, which gradually rises. In the side of the threshold which faces the north is a long artificial hole of a peculiar form, which, in some way or other, must have been connected with the gate, for a cutting of precisely the same form exists in the large flat stone in the midst of the Scæan Gate at Troy. On the suffix of the gate stands a triangular slab of gray calcareous stone, 10 feet high 12 feet long and 2 feet thick, upon the face of which are represented in high relief two animals, hitherto thought to be lions, standing on their long-stretched hind legs, and resting with their paws on either side of an altar, in the midst of which is a column, which becomes broader toward the top, and has a capital ornamented with four circles, enclosed between two horizontal fillets. This ornamentation is peculiar to Mycenæ. The general belief that the heads of the two animals are broken off is wrong, for on close examination I find that they were not cut out of the same stone together with the animals, but that they were made separately and fastened on them with bolts; most probably they were of bronze and gilded. The straight cuts and the borings in the necks of the animals leave no doubt that they were put in separately. Owing to the narrowness of the space the heads must have been exceedingly small, and must have been facing the spectator. As stated in my first letter from Mycenæ, the great resemblance of the horned animal in one of the bas-reliefs in the Acropolis to the animals on the gate makes me believe that the latter were also fantastical animals with horns. At a distance of 11½ feet from the threshold is, on either side of the passage, as in Troy, a quadrangular cyclopean masonry, two feet broad and high, and three feet long, which marks the site of a second gate of wood.

"At a few yards from the second gate I have brought to light a very curious cyclopean water conduit, leading into one of the two long and narrow cyclopean reservoirs which I had at first thought to be corridors. There is another cyclopean water conduit and another cistern immediately south of them. Both these water conduits have doubtless brought the water from the copious fountain called 'Perseia' by Pausanias, which is not, as he erroneously mentions, in the Acropolis itself, but at a distance of half a mile east of it. Its name seems to be derived from Perseus, the founder

of Mycenæ. In clearing out the 13.20-feet deep masses of rubbish which obstructed the passage of the gate, I found a well preserved bronze sealing ring, on which are engraved two young women of marvellous beauty, which seems still to be increased by their simple and graceful hair dress. Both sit close together, but their heads are turned in opposite directions. The anatomy is well observed. There were besides found a large number of Juno-idols in cow or horned-female form, and a cow idol, showing, on a light yellow dead color, a number of dark red signs, which may be letters; also, large quantities of melted lead; further, a very primitive golden ear-ring, consisting of a quadrangular golden wire twice turned round. The same form of ear-rings occurs also in the first of the four pre-historic cities at Troy, with the only difference that the wire there is round. There were also found here on the virgin soil a great many fragments of hand-made vases, having either inside and outside a plain, lustrous black or red, or a light green color, with black spiral ornaments. At only six feet behind the cyclopean wall, on the east side of the passage, I have brought to light an evidently much more ancient wall of huge blocks.

"The circular parallel double row of large slabs, which I have repeatedly referred to in my former letters, had originally been covered with cross slabs, of which a small number are still *in situ;* they are solidly fitted in and consolidated by one and a quarter to one and a half inches deep and four inches broad cuttings. As these latter exist on all the slabs, there can be no doubt that the whole circle was primitively covered in the same way. The slabs are from four feet two inches to eight feet two inches long, and one foot eight inches to four feet broad, and the largest are in the two places where the double row descends from the rock to the wall. Inside is at first a layer of large stones one foot four inches thick, for the purpose of holding the slabs in their position; the remaining space is filled up with pure earth mixed with long, thin nails in the places where the original covering remains in its position, or with household remains, mixed with innumerable fragments of archaic pottery wherever the covering is missing. This circumstance can leave no doubt that the cross slabs were removed in a remote antiquity, and it gives at the same time some idea as to the age of the double circle of slabs.

"In continuing the excavation on the north side of the cyclopean house, I brought to light two more chambers of it, and found there, at a depth of sixteen and one-half feet, three splendidly incised, perforated, round agates of a necklace, the one representing a cow head with very long horns, the other two horses standing against each other on their hind legs and turning their heads toward the spectator, just as the two animals on the sculpture above the gate must have done. Above the two horses on the agate is engraved a man with a Phrygian cap and a young woman with an uncovered head. The third agate is of a transparent red color and represents a stag, which appears to move with great velocity, although its head is turned backward. There were also found Juno-idols of a new form—e. g., a perfectly flat cow with only one big hind leg and two forelegs; a female idol with a very compressed bird's face, and with a Phrygian cap, instead of usual 'polos;' and, finally, a headless idol with all the characteristics of a woman, but with two long cow horns. There was likewise found a terra cotta cow horn three and a half inches long, which shows that there must have been much larger idols than those hitherto found. There were further found a number of small terra cotta tripods, in form of arm-chairs, cradles—in two instances even cradles with a child in them; all are gay-colored, and must have served as offerings; further, two perforated parallelopipeds of variegated color, four inches long, the use of which I can not

explain. Among the findings I may further mention a comb of bone, and six perforated, round, flat, transparent white pieces of stone of a necklace, a door button of alabaster, and a large fragment of a bas-relief representing a man with a line, probably a bridle, in the hand; he was, no doubt, represented standing on a chariot, and resembles very much the man who holds the horns of the fantastic animal in one of the bas-reliefs described in my first letter from here. HENRY SCHLIEMANN."

This brings us to the latest reports that have been made by Dr. Schliemann upon his discoveries, which are regarded by the highest scientific authorities in London as the most important yet made in the history of archæological investigation, carrying us back beyond historic times, and to a great extent overturning the theory of several modern writers on history.

THE MISSOURI MOUND BUILDERS.

A PAPER READ BY JUDGE E. P. WEST BEFORE THE KANSAS CITY ACADEMY OF SCIENCE.

GENTLEMEN: Some of you, no doubt, will remember that I stated in a paper which I had the honor of reading before the Academy of Science, at its meeting in September last, that I had reason to believe that there were numerous artificial mounds in the vicinity of Kansas City, rich in palœntological remains. In this, upon investigation, my expectations in some respects have been more than realized, while in other respects the results have not been what I anticipated, but are, perhaps, none the less important in an ethnological point of view.

From Mr. Keller's farm, overlooking a branch of Line Creek, in Clay County, to Line Creek in Platte County, a distance of about three-fourths of a mile, I have located as many as twenty-five mounds. I have seen others east of Mr. Keller's, extending as far as Randolph, and I am informed by reliable gentlemen that they are seen west of Line Creek. On the south side of the Missouri River, I have located other mounds, in the vicinity of Rock Creek, in Jackson County; but whether erected by the same people remains to be determined upon further investigation.

In shape, the mounds examined represent the frustum of a cone, and vary in size from forty to eighty feet in diameter at the base, and from eighteen to thirty-five feet at the superior plane. They are found situated on the highest points, those commanding the finest views along the summit of the bluffs overlooking the Missouri River, and with a few exceptions are arranged in groups of from three to five. Those on the left bank of the river nearly all contain buried chambers or vaults, built of stone, compactly and regularly laid, quadrangular on the inside and circular on the outside. The stones, which are undressed, on the inside are laid horizontally, and apparently have been selected with great care, the walls presenting, when the earth is removed, a smooth inner face.

XUM

The chambers, as far as opened, are nearly uniform in size and construction, being eight and one-half by eight and one-half feet, with the exception of one, which is seven and one-half by eight feet, internal linear surface, and are from three and one-half to four feet in vertical height. In the center of the south wall of each chamber is an opening, or doorway, two and one-half feet wide. They are situated due north and south, with one exception, which varies but ten degrees from a north and south line. The walls are about eighteen inches in thickness at the summit, and slope outward and downward to about five feet at the base, at the medial line of the square.

Assisted by Drs. Fee, Halley and Smith, and Messrs. Winner, Lykins, Child, Michener, Traber and McDonald, of the Academy, and Messrs. Evans, Campbell and other gentlemen of the neighborhood, I have opened five of the mounds, which are situated on the land of Mr. Peter Brenner, to whom, and to Mr. Krouse and Mr. Klamm, and other gentlemen of the neighborhood, I am indebted for many acts of kindness and for material assistance in the prosecution of my work.

Those opened I have designated the five mound group. They are in Platte County, about sixty feet west of the line dividing that county from Clay County, and are all embraced within an area of two hundred feet. I have, for convenience of description, numbered them respectively from one to five, beginning on the east.

Number one, the most easterly of the group, contains a stone chamber seven and a half by eight feet, internal linear surface, and three feet in perpendicular height, with a doorway two and a half feet wide in the centre of the south wall. Within the chamber, and on the plane of the base of the wall, five human crania and other human bones were found. Two of the crania were on the west side, two on the east side, and one near the centre. Those on the west lay on their sides, and near the west wall, facing the wall, and facing each other, and are comparatively in a good state of preservation. These two crania I have the pleasure of presenting before you this evening. You will perceive that they are both of the Dolichocephalus, or long-headed type, and that the individual to whom one of them belonged most probably suffered a violent death, from the fact that the cranium has been pierced entirely through by some missile, most probably an arrow; if so, the arrow-head used must have been very small, perhaps one of those small implements which I have often seen, but previously supposed were made for playthings to amuse the aboriginal children, but it would seem from this, that a grim, earnest purpose prompted their manufacture and use. The other crania were not so well preserved, and their outline could not be distinctly defined, but the frontal bone of one of them, and some fragments of the maxillary bones, would indicate very clearly that they belong to the same type as those found on the west side. I am not satisfied as to whether fire had been used in this chamber, but am inclined to think that it had been, on the east side.

Mound number two contained, also, a chamber constructed of stone, eight and a half by eight and a half feet, internal linear surface, and three and a half feet in vertical height, with a doorway in the centre of the south wall two and a half feet wide. This chamber contained large quantities of burnt human and animal bones, burnt clay, wood ashes and charcoal, extending from the plane of the base of the wall to within eighteen inches of the upper surface. Many fragments of human crania were found, but none sufficiently intact to preserve their outline, but, from their appearance, no doubt were of the same type as those found in mound number one. In the southeast corner of the chamber, at a depth of eighteen inches, the cranium which I next present you, was found. From its situation in the mound, and from its better preservation, and the fact that it differs so widely in type from the other crania, no doubt it was an intrusive burial, and belongs to our modern aborigines.

Mound number three exhibits no appearance of a stone chamber, so far as examined, and perhaps contains none, but may have contained a chamber of sun dried clay, every vestige of the walls of which has been destroyed by the great lapse of time since its erection. This mound, too, contained burnt human and animal bones, burnt clay, wood ashes and charcoal, so circumscribed in limit, and intermingled at the plane of the base of the mound, as to render it probable that the deposit accumulated on the floor of a chamber. It presents, too, other remarkable features in its contents. In addition to the human bones apparently, and which, no doubt, are, though in a fragmentary condition, of the same type as those found in numbers one and two, other bones are found which, if they prove to be human on further examination, as they most probably will, are certainly the most remarkable yet found, of which we have an account, throughout the entire world. Some of the bones found in this mound, which evidently are human, are so very diminutive as to preclude the idea that they can belong to the same race to which the other bones belong, or to any race of men now inhabiting the known regions of our globe. Of this type were found several fragments of crania, fragments of one lower and two upper maxillary bones, belonging evidently to adult individuals. Some animal bones were found in this mound, in respect to which I withhold any expression of opinion at present. They may prove to be those of the reindeer. These very remarkable waifs of a by-gone age I also have the pleasure of presenting for your examination.

Mound number four, like number three, has no appearance of containing a stone chamber, nor have I observed any burnt clay, wood ashes, or evidence of fire having been used in it, as far as opened. Only human bones were found in this mound, which are of the same general type as those found in numbers one and two, but some of them are more strongly marked, and are all in a fragmentary condition. I present you for examination from this mound, two frontal bones, one upper and two lower maxillary bones, and one femur. The specimens, you will perceive, indicate a

low order of intelligence and very great muscular development. Drs. Halley and Fee, from measurements made by the former, of the femur, think the individual to whom it belonged must have been as much as seven feet five inches in stature. A creature of this commanding height, supported by such vast muscular development, with a low and rapidly retreating forehead, and a very prominent supra-orbital development, over-arching, wild, restless eyes, the wild, restless, fierce expression of which was heightened by constant watching for lurking foes, must have formed an object fearful to look upon—a savage which the wildest dream of the imagination can scarcely picture.

Mound number five contained a stone chamber eight and a half by eight and a half feet internal linear surface, and four feet in vertical height, with a doorway in the centre of the south wall two and a half feet wide. Like number two, it contained a large quantity of burnt human and animal bones, burnt clay, wood ashes and charred wood, all intermingled and extending entirely over the floor, at irregular depths. In the centre of the chamber this mingled ash-heap was not less than eight inches in thickness. Beneath it, and almost, and perhaps in places, entirely in contact with it, buried in the clay, and resting on the natural surface at the plane of the base of the wall, parts of four skeletons were found, but none of them sufficiently preserved to give their outline. Three frontal and the fragments of two maxillary bones were sufficiently intact, however, to indicate very clearly that they belong to the same race of those in number one.

The mounds opened all rest upon the undisturbed natural surface. This was singularly illustrated in mound number five, in which the root of a tree growing on it had penetrated the mound, vertically, until reaching the natural surface at the base, where, rejecting the natural formation and selecting the more nutritious, disturbed earth, grew away at right angles across the base of the mound, resting horizontally on the natural surface, affording a very suggestive hint to agriculturists. The entire absence of implements in any one of the mounds opened, unless I may except four flint flakes found in number four, which, most probably, were thrown in by accident when the mound was erected, is a matter of surprise to me, and one in which I must confess great disappointment; but other mounds, when opened, may yield different results.

I stated in my September paper, that the last level of the lake in which the loess deposit took place extended some way up Line Creek. I am strengthened in this opinion by the terrace markings which I find along the bluffs on the north side of the river. I find additional evidence, too, to confirm the opinion which I then expressed, that the spear-head found at the junction of Missouri and Troost Avenues, in this city, was deposited where found while the loess deposit was yet going on. We must not infer from the absence of implements in the mounds that none were used by the race that erected them, for within a distance varying from one-half mile to a mile from them, large quantities of flint arrow and spear heads, stone

axes, knives, flint cores and chippings, flat stones used for grinding corn, fragments of pottery, etc., are found. Some of the implements, you will perceive, are very rude, while others present a superior finish. They are found imbedded in the upper surface of the loess, along old roads, and in fields that have been in cultivation for a number of years, where the superincumbent vegetable mould has been entirely removed by attrition, or other causes. A farmer residing in the neighborhood remarked to me that the older the field the more implements were revealed by the plow; that they were not encountered by the plow in fields that had not been in cultivation ten to twenty years. The surface in Clay and Platte counties bordering on the river, where these implements are found, is very undulating, and subject to rapid change by attrition, especially in cultivated fields and along public highways. Mr. Krouse, who resides in the neighborhood, on the southern slope of the bluff overlooking the Missouri, showed me a beautiful spear-head found embedded in the loess, three feet beneath the surface. Its situation in the loess cannot be mistaken, for it was found while excavations were being made for the purpose of terracing and grading his yard. At the same level numerous flint flakes were found. These implements, evidently, were deposited before a vegetable mould was formed in the localities of their deposition, and, probably, upon what was then a lake shore.

These views are sustained by my own observations, as well as by the unanimous verdict of the people of the neighborhood, as to the situations in which the implements are found. The Line Creek pottery, you will perceive, differs from that found on the south side of the Missouri, which I had the honor to describe in my September paper, and no doubt can claim a superior antiquity. The difference is obvious, and relates to the fashioning of the vessel. While the latter shows no signs of a mould having been used in the construction of the vessel, the former has clearly delineated on the outer surface the markings of the mould in which the vessel was fashioned. Independent of this marked distinction, the pottery as yet encountered on the south side of the river is found in situations indicating a more recent deposit than that found on the north side, and most probably belonged to a different race, or, if to the same race, certainly at a later period of time.

There seems to have been two eras in this country in the manufacture of pottery,—that in which a mould, constructed of grass, the inner bark of a tree, or coarse threads made of the sinews of animals or other material, was used, inside of which the vessel was moulded and given shape, and an era in which the vessel was shaped without an outer mould. The latter, though the eras may lap in sequence of time, is subsequent to the former, and extends down to our own time, for we find pottery of this latter type now manufactured and used by some of the aboriginal races of New Mexico and Arizona.

It is highly probable when the surface of the earth in the immediate

proximity of the mounds shall be disturbed by an advancing civilization that implements, now hidden by the superincumbent vegetable mold, will be found in their immediate vicinity.

As to the age of the mounds themselves, independent of the evident antiquity of the implements found in their neighborhood, they bear internal evidence of very great age, as well from the type of the mysterious race found resting in them, as from the evidence afforded by their internal structure. Careful observation failed to disclose in or beneath any one of them the least trace of local vegetable mould, while overlying them, on their external surface, the vegetable mould has attained as great thickness as is found in the surrounding country. The trees on the mounds are of the same species as those in the forest environing them, and have attained as great size and age. If there had been a vegetable mould removed at the base of the mounds before their erection, there should be some evidence remaining of its presence, either in or immediately around them; but no such evidence exists. If we consider the fact that the implements in the neighborhood are found imbedded in the loess, and the farther fact that the mounds rest upon and are entirely composed of this formation, with the exception of the accumulation at the surface, which has taken place certainly subsequently to their erection, we can scarcely escape the conclusion that they must have been built during the time the loess deposit was yet going on, or very soon after its completion, and before a perceptible vegetable mould had been formed. Prof. Aughy, in his Geological Report of Nebraska, estimates the time required for the deposit of 200 feet in thickness of loess at 20,000 years. This is perhaps a liberal estimate. The greatest thickness of the loess here does not exceed 100 feet, and the greatest thickness on the highest points, such as those upon which the mounds are erected, does not exceed 20 feet. Supposing 10,000 years for the deposit of 100 feet, 2,000 years would be required for the deposit of 20 feet; so that there would intervene 8,000 years between the last of the upper and the last of the lower deposit. After the recession of the lake waters, 8,000 years, no doubt, would give ample time for the production of a luxuriant vegetable growth, and the accumulation of a very perceptible thickness of vegetable mould.

Now, if it be true that the mounds were erected before the accummulation of a perceptible quantity of mould, it renders the high probability almost into a certainty that they were constructed before the completion of the loess deposit, and while a lake of considerable magnitude still laved a shore line extending north along the Line Creek valley and along the bluffs immediately under the mounds, that our mound builders were dwellers on the shore of a lake, which, like themselves, long since has passed away, leaving evident traces, enwrapped in mystery, of a past existence.

The great antiquity to which this necessarily leads us is not inconsistent with the immunity of the bones from decay, when we consider their evident protection from moisture, and the vicissitudes of the seasons, in the situation in which they are found, and when we consider their present chemical con-

dition. The claim to their great antiquity is further strengthened by the fact that out of three humeri found, two of them contained perforations at the inferior extremity, and from the evident great preponderance of the muscular over the intellectual development.

The question as to the purpose for which the mounds were erected is one of difficult solution. Whether the stone chambers described are merely an improvement on chambers of similar construction made of sun-dried bricks, built in the mounds destitute of stone chambers, every vestige of which has been effaced by the great lapse of time since their construction, is a problem yet to be solved, but this is rendered highly probable by the facts presented in Mound No. 3. Supposing all the mounds to have contained chambers differing only in the material used, the question still remains to be answered—were they covered, and, if so, how were they covered? That there was not a covering of wood is evident from the fact that no appearance of decayed wood is found in the mounds, except the decayed roots of trees which have grown upon them since their construction. Nor could the covering have been of stone, or vestiges of it would be found in the mounds. If covered at all, and it is highly probable that they were, the covering must have been of the brick clay of which they are composed, and which is well adapted to the purpose, made into a stiff mortar and arched over the chamber like a bake oven, with an opening for the escape of smoke at the top; or else made of the skins of animals, enveloping the top in the shape of a tent. Are we justified in considering the chambers dwelling places as well as places of interment? Many reasons seem to justify such a conclusion. The doorway in all the chambers opening to the south, the great thickness of the ash heaps on the floor of the chambers, the intermingling of bones with the ashes, and the size of the chambers themselves, which are so unnecessarily large for mere places of sepulture—are all significant facts. The depth of the mingled ash heaps in mounds two and five precludes the idea that they could have been accumulated by any ordinary funereal rites, even though protracted for weeks. The ashes in mound number three precludes the idea, in like manner, that they could have been accumulated without a chamber having been constructed in it. That there was not a succession of interments and funereal rites is manifest from the fact that the strata overlying the ash heaps had not been disturbed, there being no evidence whatever of successive openings, except for the intrusive burial mentioned in mound number two. The invariable existence of the doorway, the number of skeletons found, and the thickness of the bed of ashes, preclude the idea of a single interment, and the undisturbed upper strata precludes the idea of successive interments made at different periods of time.

The first idea of a distinctive home for shelter and protection from the aggression of enemies, probably was suggested to man in the infancy of the race by the natural caverns so often encountered on the earth's surface. To render this more probable, we find on this continent, as well as on the con-

tinents of the East, nearly all of the accessible natural caverns containing human and animal remains intermingled in relations indicating permanent occupancy. As time advanced, the natural caverns became insufficient to supply the wants of the increasing human race, and necessity suggested the erection of shelter in imitation of the architecture suggested by nature, and if we find semi-civilized, and even civilized, nations pursuing the same style of architecture for ages together, we need not wonder at primitive man pursuing the same rude style for many successive ages. The race associated with the mounds must have been much more numerous than we find resting in them, and but comparatively few could have been interred. It is probable, from the situations in which the remains are found, covered with clay at no greater depth than the plane of the floor of the chamber, that successive interments, after the soft parts of the body had decayed, were made while the chamber was occupied as a dwelling, and so near the surface of the floor that the bones were sometimes reached by the domestic fire, as I saw illustrated in mound number five. If it is objected that this intimate relation between the living and the dead is strained and unnatural, we must remember that those for whom such relation is claimed did not scruple at feasting upon their fellow man and scattering his bones around the domestic hearth; for the animal bones and the human bones found intermingled with the ashes and other debris of the floor of the chamber were perhaps only the remains of the ordinary family repast.

The absence of any implements in the mounds would indicate that our mound builders had no religious ideas, or if they had a religious belief, that they neglected to provide for their friends on their long journey to the spirit land, and for their future abode in that aboriginal Elysium. It is not probable that captives and slaves would be sacrificed to accompany the departed spirit without also providing him implements for use in the chase, in his far away spirit home. But in rejecting this poetic idea, we must adopt one which, though less pleasing, is more practicable, and though it may be revolting to our cultivated sensibilities, form the reluctant conclusion that our mound builders were a race of cannibals. But

> "Ye, whose hearts are fresh and simple,
> Who have faith in God and nature,
> Who believe that in all ages
> Every human heart is human,
> That in every savage bosom
> There are longings, yearnings, strivings
> For the good they comprehend not,"

may spread the veil of charity over the rude past.

PHYSIOLOGY AND THERAPEUTICS.

THE FUNCTIONS OF THE UVULA AND THE PROMINENCE FORMED BY THE AZYGOS UVULÆ MUSCLES.

By Thos. F. Rumbold, M. D., St. Louis, Mo.

In the spring of 1870 I had a patient whose right nostril was of sufficient caliber to admit my little finger in its whole length. The idea occurred to me at once, that this case presented an excellent opportunity for examining the action of the uvula; and as our authorities say of this grape-shaped appendage, that "its use is not clear,"* I determined to take advantage of this opportunity to inspect its motions during mastication, deglutition and vocalization.

I had the patient keep this nostril wide open with a Kramer bi-valve ear speculum. Through this large nasal passage, thus dilated, I passed a reflector, reaching to the posterior wall of the pharyngo-nasal cavity (Fig. 1, R); on the mirror (R) I directed a calcium light, illumining the parts

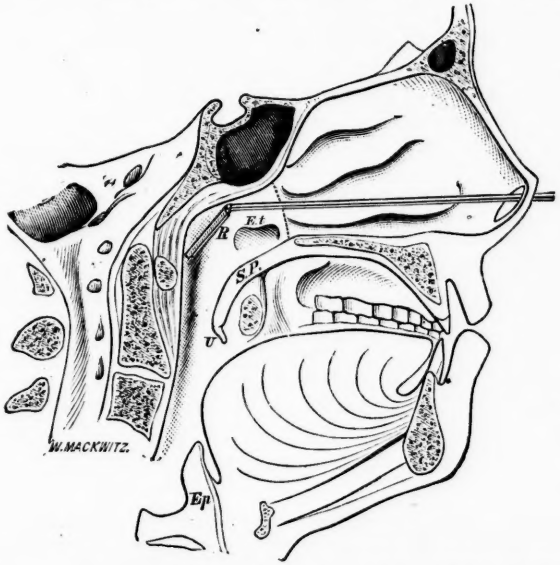

FIG. 1. Antero-posterior section of the head; R. reflector; S. P. soft Palate; U. uvula: E. t. mouth of Eustachian tube; Ep. epiglottis.

* Dunglison's Medical Dictionary.

under observation, so that the image was reflected back to my eye very distinctly. In this way I was enabled to inspect the upper or posterior surface of the soft palate, and the prominence or ridge on it that the azygos uvulæ forms (Fig. 2, Az-Pr.), the base of the tongue (T), the epiglottis (Ep), and the contents of the larynx, at the time of the attempted phonation of the sound "æ" with the mouth closed.

My observations on this patient were continued for a period of five weeks. Subsequently, I made numerous observations of a similar character on six other patients, each of whom had lost the septum nasi, but had perfect soft palates.

From notes that were taken at the time of these inspections—about seventy-five in number—I will state what part, in my judgment, the soft palate, the uvula and the azygos prominence (Fig. 2, Az Pr, and Fig. 3) take in the acts of mastication and deglutition, and what were their positions at the time of the phonation of such simple sounds, as show enough of their ac-

FIG. 2. View of the posterior nasal passages, the posterior surface of the soft palate and base of the tongue; Pt N. posterior nares; E. t. Eustachian tubes; Az-Pr. azygos prominence, on the upper surface of the soft palate formed by the azygos uvulæ muscles; S-l. Semi-lunar openings formed by the tongue, uvula and soft palate; T. base of tongue; Ep. epiglottis; U. uvula.

tion to demonstrate their apparent function; reserving for the near future, the details concerning the position of these three organs as well as that of the base of the tongue and the epiglottis during the phonation of specified sounds.

Although I know now that the uvula and azygos prominence (Figs. 2 and 3) are not required to aid the acts of mastication and deglutition, yet I will give the results of the inspections while these processes were going on, because these results contain points of interest when taken in connection with phonation.

During mastication the whole free border of the soft palate rested on the base of the tongue, reaching within a short distance of the epiglottis. In five of the cases, the uvula was not in sight at any time, and seemed to be doubled under the velum, so as to lie between it and the tongue (Fig. 4).

Two patients had elongated uvulas, which, sometimes, hung down on the base of the tongue, and frequently touched the epiglottis. The uvula was always contracted; the evidence of this condition was the increased height

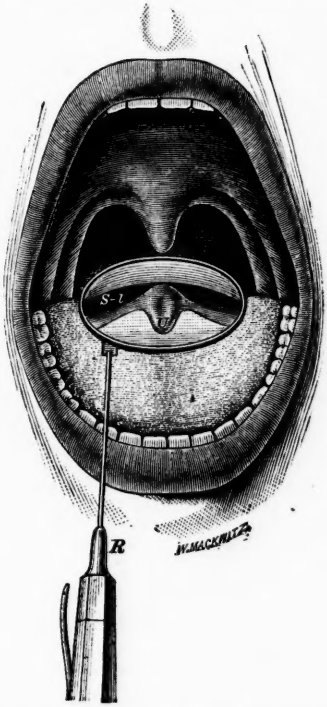

FIG. 3. The image, seen on the hinged reflector (R), of the lower edge of the soft palate and the lower or posterior concave surface of the uvula (U), showing, also, the higher semi-lunar shaped openings (S-l) made by the azygos prominence touching the posterior wall of the pharynx.

of the azygos prominence, formed by the contracted azygos uvulæ (Fig. 2, Az-Pr).

During the act of deglutition, the soft palate was pushed backward by the alimentary bolus until the posterior wall of the pharynx was reached; the motion was continued in an upward direction until the upper surface of the velum was high enough to cover and close both Eustachian tubes (Fig. 1, S. P. E. t.), pushing the reflector (R) upward and forward; then the velum descended, as the alimentary bolus was swallowed, until its lower border touched the base of the tongue.

When I began to make observations, my attention was directed to the uvula alone; but the varying height of the azygos prominences during vocalization (Fig. 2, Az-Pr.) in this, my first patient, drew my attention to it, and what I discovered with respect to it, was confirmed in the subsequent

examination of the other cases, namely: that this prominence, whose existence I had known for some time, though I had never thought of assign-

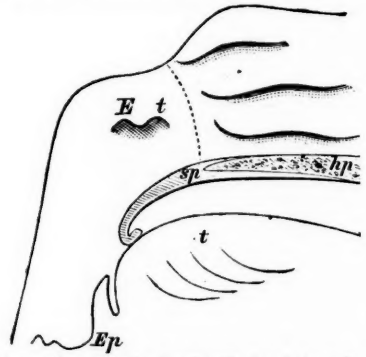

FIG. 4. Antero-posterior section of the hard palate (hp.) and the soft palate (sp.), showing the position of the uvula resting on the base of the tongue (t.); Ep. epiglottis; E. t. mouth of Eustachian tube.

ing to it any function or use, was of as much importance in vocalization as, if not more than the uvula itself; so that, while seeking for the function of this grape-shaped appendage, I discovered a new organ, and ascertained its function at the same time.

During the vocalization of sounds that passed through the nose alone, the whole free border of the soft palate rested on the base of the tongue (Fig. 4), the uvula was not in sight at any time. During the vocalization of sounds that passed through the mouth alone, the soft palate was raised, and about 4‴ of its lower border was pressed against the posterior wall of the pharynx (Fig. 5).

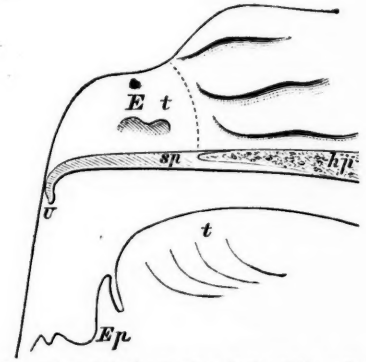

FIG. 5. Antero-posterior section of the hard palate (hp.) and the soft palate (sp.) showing the position of the velum closing the avenue to the pharyngo-nasal cavity; U. uvula; t. tongue; Ep. epiglottis.

From repeated inspections made while the velum was in each of these two positions, it appeared that all the sounds were uttered without the aid of either the uvula or the azygos prominence.

The favorable opportunity for observing what assistance is rendered by the azygos prominence and the uvula, is during the phonation of such sounds as are required to pass through the mouth and nose at the same time. While these sounds were uttered, the soft palate was either suspended, so that but a small part of its central portion and the uvula rested on the base of the tongue (Fig. 6), or it was raised to such a height that the azygos prominence touched the posterior wall of the pharynx (Fig. 3). In each situation that the velum occupied, the communication between the fauces and the mouth, and between the fauces and the pharyngo-nasal cavity, was divided into two equal, or nearly equal, semi-lunar openings. In the first position named, the division was made by the uvula and a small part of the central portion of the velum resting on the base of the tongue (Fig. 6, S-l), and in the second position, the partition was made by the azygos prominence (Fig. 3, S-l), touching the posterior wall of the pharynx.

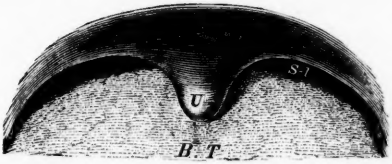

FIG. 6. View of the anterior surface of the soft palate, the uvula and the base of the tongue, showing the lower semi-lunar-shaped openings (S-l') formed by the uvula (U.) and a part of the central portion of the velum resting on the base of the tongue (B. T.).

In one patient I noticed, on several occasions, that the uvula seemed to be resting on the base of the tongue, while, at the same time, the azygos prominence was touching the posterior wall of the pharynx.

The formation of the inferior or posterior surface of the uvula (Fig. 3, U), as well as the peculiar position in which it hangs from the velum (Figs. 1 and 2, U), indicates that this surface lies on the base of the tongue frequently, its extremity being directed forward (Fig. 4). It is evident that this position is the best one in which it could be placed, to prevent the free edge of the soft palate from being shaken by the force of the air from the lungs.

It was observed repeatedly, that the free border of the velum was not at any time suspended in the current of air during vocalization, but was always situated in such positions that it received support, which prevented it from being thrown into vibrations by the force of the air that came from the larynx. To show how the support was given, I will mention again all of the principal positions that this vocal valve was observed to assume. (*a.*) It was either elevated and pressed against the posterior wall of the pharynx (Fig. 5, U), during the phonation of sounds that passed through the mouth alone; or, (*b.*) removed from this wall a small distance, but not so far as to prevent the azygos prominence from touching it (Fig. 3, seen in the image on the reflector R.), for sounds that passed mostly through the mouth and a little through the pharyngo-nasal cavity; or, (*c.*) lowered to allow the

uvula and a small part of the central portion of the velum to rest on the base of the tongue (Fig. 6), for sounds that passed mostly through the nose and a little through the mouth; or, (*d.*) still lower, so that its whole free border rested on the base of the tongue (Fig. 4), for the formation of sounds that passed the nose alone. In a few instances, as have been mentioned, I have seen the second and third positions combined, *i. e.*, the uvula resting on the base of the tongue, and the azygos prominence touching the posterior wall of the pharynx at the same time (Figs. 6 and 3).

From the effects of these positions of the velum on phonation, it would appear that one of its functions is to act as a valve, by directing the voice from the larynx into the mouth alone for the formation of one kind of tone; into the nose alone for another; and to divide the sound so as to allow it to escape from both of these openings, for still others. It is evident that while the velum is resting wholly on the base of the tongue, or is pressed against the posterior wall of the pharynx, the liability for its free border to vibrate by the force of the air is reduced to a minimum; but when this valve is in either position that requires it to divide the sound between the mouth and the nose, then, on account of its free edge being suspended and placed immediately in the current of air from the larynx, the liability for it to vibrate is increased to a maximum.

A provision is necessary to prevent these vibrations. This provision, I am led to believe from my observations, is found in the uvula and the azygos prominence formed by the azygos uvulæ muscles. It is located in the centre of this very mobile palate or valve, and by its support in both of the positions that require suspension (Figs. 3 and 4), prevents it from being shaken by the force of the current of air from the lungs. There can be no doubt, that if there were no uvula and azygos prominence to prevent this thin edge of suspended flesh from vibrating, it would be shaken to such a degree as to impart a tremulousness to the tone of all sounds forcibly uttered that pass through the mouth and nose at the same time.

The following questions have been asked frequently:

"1st. If the uvula is required to prevent the free border of the velum from vibrating during phonation, will not its loss impair the voice?"

"2d. How do you account for the improvement of the voice in many instances, after its removal?"

The excision of the uvula can effect those sounds only which are formed by its assistance, and not even then, if they are pronounced with the usual strength of voice, because the contact of the central portion of the velum on the base of the tongue will be support enough to prevent the velum from being shaken; therefore, the difficulty in pronouncing, in high and loud tones, those sounds that are required to pass mostly through the nose and a little through the mouth, will be in proportion to the amount of loss of support that the velum suffers; as usual excisions leave a stump of the uvula and the central portion of the soft palate, these will prevent any vibrations during speech made with the *usual* force of the lungs.

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I have observed that a patient, who has just undergone an operation for excision of an elongated and hypertrophied uvula, may talk immediately in an *ordinary* tone with greater ease than before the operation, but, just as soon as he utters words with *more* than the *usual* force of voice, such, for instance, as he would require to address a person across the street, some of the efforts will remind him of the excised uvula, and though not causing as much pain as the knife did, will cause so much that he will be compelled to cut his sentence short of its intended length. The reason of this effect on the uvula appears to me to be this: the heavy uvula had given so much support to the soft palate that, although it had been acting as an impediment to all kinds of sounds, the velum required very little of its own pressure on the base of the tongue (Fig. 6) to prevent it from being thrown into motion by the air from the larynx, but when the superabundant portion of the uvula was removed, the velum required greater pressure upon the base of the tongue to prevent these vibrations, and this pressure was the occasion of the pain. Of course the loss of the whole of the uvula does not interfere with the formation of the two semi-lunar-shaped openings by the free border of the velum and the dorsum of the tongue (Fig. 6), by which the voice is allowed to escape from the mouth, and thus provide for perfect vocalization; it takes away a *part only* of the support from the soft palate. Even if there be no stump left by the excision, the tongue will learn to overcome the defect by the increased elevation of its dorsum, which may be made more convex than was required to form the two semi-lunar openings when the whole of the uvula was present, and in this way allow both a greater pressure and more of the central portion of the velum to rest on the tongue. But if the soft palate suffer so much of a loss of substance in its central portion, that its concavity is equal to the convexity of the dorsum of the tongue, thereby preventing the formation of the semi-lunar-shaped openings, and neutralizing all support, there will be some sounds, such as pass mostly through the pharyngo-nasal cavity and a little through the mouth, given imperfectly in spite of all efforts to overcome it, because the proper tone requires that the velum should be raised to allow a part of the sound to pass to the mouth, and this act of elevation exposes it to the force of the air from the larynx, which force is the cause of the imperfection of the sounds, by causing the unsupported edge to vibrate. Again, if the loss in the centre of the velum be greater than can be closed by the greatest convexity of the dorsum of the tongue, the disability will be equal to that caused by a perforation of the soft palate, and in addition, there will be a tremulousness to many semi-nasal tones, on loud speaking, as addressing an individual at a distance. That the intermittent tone is occasioned by the vibrations of the central portion of the velum, is evidenced by the pain in this part after lengthy speaking in a loud voice. This pain was experienced by two patients while under my care, whose soft palates were notched to this extent by ulceration.

In answer to the second question—"How to account for the improvement of the voice after the removal of the uvula?"—I would ask, if it is

claimed that this improvement in speech is equal to the patient's vocalization at the time that his uvula was in a healthy condition. I am sure, because the observations made on this subject during the last five years have taught me to be so, that the answer to this question should be given in the negative. That a relative improvement in speech does follow an excision of an elongated or hypertrophied uvula there can be no doubt, because this operation brings the organ nearer to its normal size and condition; but it resembles the improvement made by perforating the membrana tympani in a case of deafness caused by a closure of the Eustachian tube; such improvement can never equal the normal function of the organ. This being the case, the effect of the excision will be to remove the cause of a mechanical hindrance to every word uttered by the patient, made in any degree of force, and it will leave a stump which will not be a cause of hindrance, but a cause of an inability to pronounce some words on forced vocalization only, and this even will be overcome in time by the dorsum of the tongue becoming more convex. Therefore, to admit that the removal of a uvula thus diseased may improve the ability to speak in the usual tone of voice, does not prove that it was the uvula's removal that was the origin of the improvement, for, if such were the case, the excision of the healthy uvula would not only be advisable, but desirable.

The effect of the amputation of the whole of the uvula, besides its being a loss of the greater part of the support to the velum, prevents the formation of the azygos prominence to its greatest height, which is done by the contraction or elevation of the azygos uvulæ muscles, which terminate in uvula. This height of the prominence is required to prevent, by its contact with the posterior wall of the pharynx, the vibrations of the velum during the formation of many semi-nasal sounds.

The nearer that the surgeon can make the diseased uvula take the shape and size of the normal one, the nearer will it approach its normal function, that is, rendering the soft palate a non-vibratory valve, which is required for perfect phonation.—*St. Louis Medical and Surgical Journal.*

JUVENILE NEAR-SIGHTEDNESS.

The following extract from a report made by Dr. James A. Spaulding to the Maine Medical Association, while applying chiefly to the children of the Portland schools, will be found of decided interest to all teachers and parents, as well as to school boards having the construction of public school buildings in charge. The number of near-sighted young people is alarmingly on the increase here as well as elsewhere, and the subject of prevention deserves and demands earnest attention and prompt action where it is found necessary:

"For some time past I have been occupied in making an examination of the sight of the children in the various primary and grammar schools of

the city. It had also been my intention to examine the scholars in the high schools, but, owing to some mistakes and misunderstandings, nothing was done in these schools. The method of examination was as follows: Each scholar was tested singly with Sneller's test type at twenty feet distance, in a bright room. Those whose sight was in any way affected were in this way sifted out from those with good sight. After this had been carefully done, in some cases by the teachers, to whose accuracy and care I owe my thanks, and in some by myself, I tested each scholar with defective sight with the series of larger test type, found the exact proportional amount of sight, and then corrected it by convex or concave glasses, as the case might demand. Where no improvement could be obtained by either concave or convex glasses, astigmatic glasses were tried. Some of the scholars with defective vision, which could not be corrected by glasses, were examined with the ophthalmoscope. In regard to the latter point, I regret that I was unable to make more extended search. In all, 2,372 children were thus tested.

"The results may be thus briefly stated: In the grammar schools I found twenty per cent. of the children with defective sight, and in the primary schools eight and a half per cent. Of these twenty per cent. in the grammar schools, I found sixteen per cent. in all who were at all short-sighted, while ten per cent. of the whole required glasses stronger than thirty-six inches focus to correct the myopia present. Of the eight and a half per cent. in the primary schools, I found seven per cent. who were short-sighted, and of the whole, three and a half per cent. who required glasses stronger than thirty-six inches focus. To repeat, there was ten per cent. myopic, requiring a glass stronger than thirty-six inches focus for correction in the grammar schools, in children from ten to fifteen years of age; and three and a half in the primary schools, in children from five to ten years of age. Myopia was more common, in the proportion of five to four, among girls than boys, especially in the higher degrees. In quite a number of cases of high degrees of myopia, it was impossible by any kind of glasses to bring about perfect sight, thus showing that short-sight in high degrees is attended with a defect of visual power, and is not a blessing, as some people will persist in insisting upon.

"The first point on which I would speak is lighting the school rooms. How, then, are they off for light? In reply it may be said that some of them are remarkably well lighted, and noticeably those of the North School, where the light comes in brightest from one side, and from the other side and rear in subdued amount. Some are moderately well lighted, as those in the High School building, with equal light from both sides; but where the windows are not cut up high enough toward the ceiling, they do not let in light enough on a gloomy day to make the middle rows of seats desirable for any scholars at all, even those with the sharpest eyesight; while some, and especially the Park Street Grammar School, are miserably lighted. In this school the light strikes directly in the faces of the scholars, and also directly upon their backs. Thus they have a glare in front and a shadow thrown from behind. In this school, and in a school similarly lighted on Brackett street, I found the greatest percentage of defective sight. It always seems to me just as absurd to read with the face directed toward the brightest source of light, thus placing the eyes in the most disadvantageous position possible, as it would be to weigh down one's self with fetters when going walking.

"It is useless to suggest that the teachers of a crowded school might find time to watch the scholars with defective sight, to see that they do not hold their books too close to their eyes, or to make them hold their books up

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from the desk and parallel to their faces, or to prevent too long and unremitting search for unimportant places in an atlas. But what the teachers can do and ought to do is this: Every scholar known to have defective sight ought to have a seat in the very best light in the room, irrespective of what class each may belong to. I would range the defective-sighted scholars along each outer row of desks as near to the windows as possible, where the light comes from the sides; while in those schools which are so unfortunate as to have the light from the front and back both, I would put them on the rows of seats nearest the back windows.

"In every school there should be a rest every half hour, if even for a minute only, from reading, and especially from writing and drawing, the pursuit of which, for a steady hour, is wearisome enough to a practiced eye, and much more so to all young beginners, who strain, as it were, at each point in a line, so as to make it as nearly like the copy as possible. Fine handwriting ought never to have been invented, and especially in the ruled-off way—the measured space way—in which it is taught nowadays. Any child taught a large, round, flowing hand will soon learn enough to make it proportionately smaller, as space and paper demand.

"In examining a few of the scholars who wore glasses, I was struck with the general and unnecessary strength of their glasses. Too strong glasses require too much exertion of the eye. Glasses for short-sighted persons should be the weakest possible with which they can see clearly at a distance, while for reading they should, except in some rare cases, be still weaker.

"Shall we give glasses for reading in short-sight? For children whose sight can be perfectly corrected by concave glasses, that is, if there be no amblyopia as a result of myopic distension of the eye-ball, with changes in the inner tunics of the eye, and if the eye has good power of accommodating itself for near objects, I see no objection to their wearing glasses; and with this advantage, that, if worn early in life, they will, in all probability, prevent a further increase in the myopia. After twenty years of age, and with advancing age, they may be diminished in strength, or even convex glasses may be worn.

"But, after all, the only place to teach children how to use their eyes well—how not to abuse them—ought to be at home. They should be taught that the light should always come from the side, or even over the shoulder; that the book should be kept up, if possible, and never in the lap; that they should always have a shade over a lamp standing on a table at a level with their eyes, and especially if they have to face the light, as in writing; and that all bending positions, and reading in the twilight, or with the sunlight pouring over the book, are very harmful to the eyes.

"In some of the school children I found myopia hereditary, being traceable to parents and even grand-parents, and the points just mentioned about the use and abuse of the eyes can not be too strongly urged upon the parents and taught by them to their children, when they know that they themselves have defective vision, and that it is often hereditary, descending to their children in increased degree unless carefully watched.

"It is useless to create a panic about short-sight, or to say that, with advancing education, we are growing a race of short-sighted persons. It is wrong to accuse the schools as the sole cause of all cases of short-sight. That would be carrying a few facts, a few statistics, to an unwarranted extreme. Hereditary influence I believe to be a great effect in causing short-sight, while bad light at night, at home, poor light in the school-rooms, want of care in selecting well-printed books, urging girls too much to learn fine sewing and embroidery, too long-continued and unrested work at

school, too strong glasses given by opticians, and many bodily ails and weaknesses, such as scarlatina and measles, are other factors always busy in producing and continuing short-sight, all of which may, with care and thoughtfulness, be to some extent obviated, and naturally at no better time than during the years at school."

THE VALUE OF CONDIMENTS.

By condiments we mean substances like sugar, spices, vinegar and others that are employed to impart flavor and piquancy to the staple foods. They are usually regarded as non-essential, and some writers on dietetics have gone so far as to condemn their use, unless in rare instances and in the most infinitesimal proportions. Like all good things they are liable to be abused, but when properly used they are valuable elements in our daily food. Professor Voigt, of Munich, than whom there is no higher authority on such a subject, considers that their importance has not been sufficiently recognized. It is not enough that food should contain alimentary principles in proper quantity; to render it really nutritious there must also be a supply of condiments. These have been compared to oil in a machine, which neither makes good the waste of material nor supplies motive power, yet causes it to work better; they render essential service in the processes of nutrition, though they are not of themselves able to prevent the waste of any part of the body. "A dietary deprived of condiments, a mere mixture of alimentary principles without taste or smell, is unendurable, and causes nausea and vomiting." It is not until condiments are added to aliment that it really becomes food. Extreme hunger may enable us to dispense with them, as it may compel us to devour what at other times would be disgusting, but under ordinary circumstances they are an essential part of our diet.

Condiments have an important influence upon the process of digestion and nutrition. The mere sight or thought of a savory dish "makes the mouth water"—that is, it makes the salivary glands pour out their secretion copiously, which is an important stage in digestion, especially for certain articles of food. Experiments made upon dogs show that a similar effect is produced upon the gastric secretion, and thus the work of digestion is further promoted. The loss of the sense of taste would be not merely a loss of enjoyment, but a positive injury to the digestive system. The very smell of food may do us good, just as certain odors will restore a person who has fainted.

It does not follow, because condiments are useful, that we may not have too much of them; on the contrary, their best effect depends upon their being used in moderation. The more decided the flavor of any article of food, the sooner does it pall upon the appetite. It is one of the peculiar merits of French cookery that flavors are so delicately blended; no one is specially prominent, and yet by their different combinations a wonderful variety of appetizing effects is produced. We Yankees, like the English, are apt to use condiments in a coarse, reckless way, and thus miss their finer and more exquisite effects, besides losing much of the benefit that might be derived from them. By a nicer care in their employment, the plainest and simplest diet might be made at once more delicious and more digestible.—*Journal of Chemistry.*

DIPHTHERIA.—It has lately been discovered by a Boston physician that hyposulphite of soda, which is extensively used in photography, is a specific remedy against diphtheria. The discoverer, Dr. Chenery, reports a large number of cases (158 in his own practice) saved by the use of this remedy. The dose is from 5 to 15 grains or more in syrup, every two or four hours, according to age and circumstances. A large dose will do no harm, except that it will cause the patient to purge. The solution or mixture can be used in doses of five drops to half a drachm in milk, which is perhaps the best way of administering it to young children.

Dr. David Price of Leveritt, Mass., writes that there is little danger when the disease is taken in hand by the physician at the outset, with the following treatment: Chlorate of potassa, 2 drachms; hot water, 6 ounces; alcohol, 4 drachms; Creosote, 8 drops; muratic acid, 30 drops. This is to be used as a gargle every thirty minutes. Internally, he prescribes the following remedy: Chlorate of potassa, 3 drachms; water, 6 ounces; sugar, 1 ounce; tincture of muriate of iron, 2 drachms. Dose, a teaspoonfull every four hours. He says that with this treatment not one case in twenty will die, but the disease will give way in a few hours, and convalescence will be rapid.

ANY effective method of treating that terrible scourge of childhood, scarlet fever, is of universal interest. A correspondent of the London *Lancet* writes that he has obtained remarkable success in treating the disease by anointing the patient twice daily with sulphur ointment, and administering five to ten grains of sulphur in a little jam three times a day. Besides this the room was filled twice a day with sulphur fumes. He states that under this treatment "each case improved immediately, and none were over eight days in making a complete recovery."

IF small-pox can be cured with cream of tartar, it is time everybody knew the fact. A correspondent of the Liverpool *Mercury* says that it is not only a never-failing remedy in the worst cases, but it is also a preventive. The directions are to dissolve one ounce of cream of tartar in a pint of boiling water, and to drink, when cold, at short intervals. Not a very exact prescription, to be sure; but the remedy is so simple that it may be well worth trying. It is said that thousands have thus been cured, and that no marks of the disease remain.

IN regard to the use of fruits so that they shall promote, instead of impairing health, a London journal says: "When fruit does harm, it is because it is eaten at improper times, in improper quantities, or before it is ripened and is fit for the human stomach. A distinguished physician has said that if his patients would make a practice of eating a couple of good oranges before breakfast, from February to June, his practice would be gone. The principal evil is that we do not eat enough fruit; that we injure its finer qualities with sugar; that we drown them with cream. We need the medicinal action of the pure fruit acids in our system, and their cooling, corrective influence."

ENGINEERING.

CONTINUOUS RAILWAY BRAKES.

We find in *Engineering*, of January 5th, a series of diagrams and tables illustrating the competitive trials of the Westinghouse Automatic, and Smith's Vacuum Brakes, upon the North British Railway, under the direction of Mr. Drummond, general manager.

While it is impossible to reproduce the diagrams here, we will give some of the more important results, as shown by the tables, premising that the prominent essentials of an efficient continuous railway brake are promptness of action, the power to bring a train to a state of rest in the shortest time, and the ability to be self-acting in case of separation of a train, and that in these trials "the trains were about of equal weight, the engines exactly alike, the brake blocks applied to the wheels in the same manner, the percentage of weights not retarded by the direct application of the brake blocks nearly the same in each case, and the trains run on the same day, under uniform conditions of weather, while the results were taken in precisely the same way on each train, in a way which met with the acquiescence and approval of the representatives of both systems alike."

TEST NUMBER 1.

Smith's Vacuum Brake:
Boiler pressure on applying ejector.....138 pounds
" " on shutting off ejector.....138 "
Vacuum..... 17 inches
Westinghouse Automatic Brake:
Pressure in air reservoir..... 85 pounds

TEST NUMBER 2.

Smith's Vacuum Brake:
Boiler pressure on applying ejector.....144 pounds
" " on shutting off ejector .....144 "
Vacuum..... 18 inches
Westinghouse Automatic Brake:
Pressure in air reservoir..... 90 pounds

TEST NUMBER 3.

Smith's Vacuum Brake:
Boiler pressure on applying ejector.....140 pounds
" " on shutting off ejector.....137 "
Vacuum..... 17 inches
Westinghouse Automatic Brake:
Pressure in air reservoir..... 90 pounds

TEST NUMBER 4.

Smith's Vacuum Brake:
Boiler pressure on applying ejector.....144 pounds
" " on shutting off ejector.....142 "
Vacuum..... 18 inches
Westinghouse Automatic Brake:
Pressure in air reservoir.....97½ pounds

TEST NUMBER 5.

Smith's Vacuum Brake:
Boiler pressure on applying ejector.....108 pounds
" " on shutting off ejector.....108 "
Vacuum..... 20 inches
Westinghouse Automatic Brake:
Pressure in air reservoir..... 90 pounds

REFERENCE NUMBERS.	TEST NO. 1.		TEST NO. 2.		TEST NO. 3.		TEST NO. 4.		TEST NO. 5.	
	S. V.	W. A.	S. V.	W. A.	S. V.	W. A.	S. V.	W. A	S. V.	W. A.
Speed of trains in miles per hour at application of brakes.....	29.5	30	40	46	49.5	49.75	54	54	55	55
Number of seconds occupied in making stop.....	17.25	13	23	16	27	19	28	21	28	21
No. feet run in making stop.....	480	328	800	550	1250	798	1310	952	1375	910
Foot tons of energy in train, including influence of wheels at application of brake $Wr^2 \div 2g$...	5036	4995	9256	8880	14.159	13.736	16.840	16.184	17.450	16.789
Retarding power of brakes in lbs. per ton, deduced from distance run after applying brakes (including influence of wheels).....	146 31	221 9	150.85	235.8	158.24	256.3	179.63	24.72	177.54	269.5
Retarding power of brakes in lbs. per ton, deduced from time occupied in making stop (including influence of wheels).....	184.47	256.6	193 41	277.5	203.5	290.6	214.67	28.50	218.03	290.08
Speed of train (miles per hour) after brakes had been applied over 100 feet.....	29.5	28.25	39.75	39.75	49.5	49.5	53.75	53.25	54.75	53.75
Speed of train (miles per hour) after brakes had been applied over 200 feet.....	27.5	22	39.5	37	49.25	47.5	53.25	52	54	52
Speed of train (miles per hour) after brakes had been applied over 300 feet.....	23.25	13	38.25	33	48.75	43.5	52.25	48.25	53	48
Speed of train (miles per hour) after brakes had been applied over 400 feet.....	17.5	Stop'd	36.25	25.75	48	40	51.25	44.75	52	43
Speed of train (miles per hour) after brakes had been applied over 500 feet.....	Stop'd	"	32.05	16.5	46.75	35	48.5	40.5	50	39
Speed of train (miles per hour) after brakes had been applied over 900 feet.....	"	"	Stop'd	Stop'd	35	Stop'd	36.25	15	38.25	7

We quote that portion of the article bearing more particularly upon the trials made by the North British Railway Company:

"We publish this week a very complete table in which are arranged all the important deductions from these trials, as well as a second sheet containing exact reproductions of the diagrams taken, and some miscellaneous data. These diagrams and the table taken together are so clear as to require little comment. We propose, however, to point out some of the most interesting features in them. It will be observed that, for convenience of comparison, the stops made by the Vacuum and Automatic trains are arranged in pairs, the initial speeds in each pair corresponding, if not exactly, at least so nearly as to preserve the comparison accurate. In the same way the lines recording both Vacuum and Automatic stops for the corresponding speeds are arranged upon one diagram, the index figures attached to which are repeated in the Table. These figures show the number of the stops made on the day of the trial, and all of which we have not thought it necessary to reproduce.

Diagrams Nos. 2, S. V. and 3 W. A. (Test No. 1), refer to the performances of the Vacuum and Automatic brakes respectively, and the lowest speed at which stops were made. An analysis of this diagram and its re-

sults applies equally in its degree to the higher speed stops, as it will be observed that the relative efficiencies of the Vacuum brake to the Automatic vary but little independent of speed. The time occupied is here nearly half as long again, as is also the distance run. The total foot-tons of energy in the Vacuum train are rather greater than in the Westinghouse, although the speed of the latter is somewhat higher. The efficiency of the Westinghouse brake, as compared with the Vacuum, is, however, much higher, even when both are in full work, while the latter is not in operation in reducing the speed until some considerable distance has been run after the moment of application. Thus, in the diagrams we are just now considering, it will be observed that the speed of the Vacuum train was unaffected at a distance of 100 ft. after application of brakes, and when the Westinghouse had already done more than 5 per cent. of its work by reducing the train speed from 30 to 28.5 miles per hour. This distance is much more marked at the end of the third 100 ft., when the speeds stand 23.15 and 13 respectively, and the train energies at 3216 and 938 tons, so that the values of the two brakes at this point as regards speeds are in the proportion of 1.77 to 1, and as regards train energy destroyed 3.4 to 1. In other words, when the Automatic brake had performed its work, the Vacuum train was still traveling at a relatively high rate of speed. This result is, of course, more striking, in the higher velocity stops. Thus in one of the three trials at 40 miles per hour, the speeds at 500 ft. from application of brake (Test No. 2) are 32.5 and 16.5 respectively, or almost exactly 2 to 1, while the foot-tons of energy are in the ratio of 4 to 1. In other experiments this is far more strongly marked, as in the trials 12 S. V. and 12 W. A. (Test No. 4), where the speeds were in each case 54 miles an hour. In these, at the end of 900 ft., the speeds are 38.25 and 7 respectively, or $5\frac{1}{2}$ to 1, while the foot-tons of energy were 8400 against 270. The Vacuum train was thus proceeding at a rate of over 38 miles an hour, or faster than the train which was wrecked at Arlsey Siding the other day, after the Automatic train was at rest. Of course, it is in these stops at the highest speeds that the qualities of the two brakes manifest themselves; they have more work to do, and as they require a longer time in which to do it, they afford better opportunities for analysis. Thus taking runs 11 S. V. and W. A. (Test No. 5), at 55 miles an hour, we find that the time required for the former is one-third greater than for the latter, and the distance run 50 per cent. greater. In these particular tests an interesting point occurs, which manifests itself on the diagram. The Westinghouse brake was not applied until a brief interval after the diagram was commenced. The consequence was that while the Vacuum train was lessened in speed 45 per cent., the Westinghouse train remained almost at its normal velocity. But during the second 100 ft. the Westinghouse performed 7.27 per cent. of its work against 1.82 per cent. of the Vacuum train, and it is only until 400 ft. are passed that the Vacuum brake approaches its full performance, which, however, is not reached till after the Automatic brake has arrested the train. In fact, the whole of these trials clearly show the disadvantages inherent to the Vacuum system, which we have consistently pointed out—an unavoidable slowness in action at the moment when the promptest application possible is required. The somewhat interesting comparison that these trials render practicable between the detailed performances of the two systems, and a theoretically perfect stop, we shall have to defer till another occasion, remarking only meantime that while the Westinghouse Automatic shows an average percentage of absolute efficiency of about 65, the Vacuum falls to 30, while taking the absolute thoretical distance that must be run in making a stop, the ratios are about as 70 to 50.

"The tables and diagrams which record the whole results of the trials

call for little further remark. It should be borne in mind that the foot-tons of energy given do not represent the total *vis viva* of the train, which must be always a certain amount in excess of the energies tabulated. These amounts—due to the influence of the revolving wheels—are interminable, but must always fall short of the total energies stored up in the wheels, so that they represent at a maximum only a small addition to the total foot-tons.

"Speaking generally of the experiments, it should be remarked that they were conducted by the gentlemen who had undertaken the work on behalf of Mr. Drummond, with the utmost care, so that perfect reliance may be placed in the results obtained, excepting so far as certain small irregularities were occasionally developed in the diagrams that declare themselves on inspection of the table, and do not affect the general results.

"In our article on page 279 of our seventeenth volume, we observed that 'the Westinghouse brake, admirable though its performance was, is capable of far better things as regards promptness in stopping the train. * * * There can be no doubt that the increased value of the retarding force per second, as compared with the resistance per yard, indicates a want of promptness either in the handling or in the action of the brakes.' These remarks referred to the brake as originally introduced upon English railways by Mr. Westinghouse, and the criticisms we then passed have been found to be fully justified by the great improvement he has since made, and which developed into the Automatic brake, that made its first appearance here at the Newark trials. The work performed by it on the North British Railway the other day, was generally better than that done on the former occasion, and it would now seem that the system is susceptible of but little further improvement. The same remark also applies to the Vacuum brake, although, as already stated, the performances on the North British Railway are not a true indication of its actual capabilities, having been increased by the aid of auxiliary means not used in practice. Still both systems are now before the public in almost their best form; what they are capable of absolutely and relatively doing is now clearly known, and there can no longer be any excuse for hesitation in adopting one or the other of them, on the alleged want of knowledge as to which is the more efficient of the two. The necessity for some means of controlling trains is proved weekly by accidents of more or less severity upon one or other of our railways, and we fail to see upon what grounds, those with whom the power of adoption rests, fail to make use of means ready to their hands, or why in making a selection they prefer one system that falls 50 per cent. below the degree of efficiency of another."

STEAM TROLLY.

Mr. Joseph Green Cooke, the locomotive and car superintendent of the Oude and Rohilkunde Railway, has constructed a steam trolly or carriage, the object of which is to enable resident engineers to inspect their tracks, bridges and works with rapidity without being obliged to travel by train. Its weight being less than 1200 pounds, three men can remove it from the track in fifty seconds, and for that purpose it is constructed in three parts, viz: 1st, its fuel and water boxes; 2d, the boiler, frame, engine and one pair of wheels, and 3d, the front wheels.

The trolly has one steam cylinder only, this being $3\frac{1}{8}$ inches in diameter, and 6 inch stroke, and the connecting rod being coupled direct to the one

end of the driving axle. The boiler is constructed on the Field system and has 12 square feet of heating surface, composed of 36 Field tubes. The working pressure is 100 lbs. to the square inch. The diameter of the wheels is two feet, and the speed from 10 to 20 miles an hour, according to the weather. The boiler when empty weighs 156 lbs. and will hold 3½ gallons of water. The fuel box and tank together weigh 50 lbs. when empty, and will carry 50 lbs. of coal and 6 gallons of water. The engine exclusive of crank and axle weighs 45 lbs. Seven persons can ride upon it at the same time.

APPARATUS FOR BURNING CRUDE PETROLEUM IN LOCOMOTIVES.—Thomas Urquhart, Superintendent of the Griazitzaritzen Railway of Russia, has designed an apparatus for burning crude petroleum or naphtha waste in locomotives, which is described with illustrations in *Engineering*. The petroleum for this purpose is brought from Baku on the Caspian Sea, being transported by water up the Volga to Izaritzin, the terminus of the railway, and it was expected that it would take the place of wood in the Russian railways. While it has been comparatively successful from an engineering point of view, there are some objections, among which are the great amount of smoke made when the locomotive is standing, and the fact that several severe gas explosions have taken place on the firing door being opened. In addition to these objections it has been demonstrated that the use of petroleum is more expensive than that of wood.

METEOROLOGY.

THE METEOR OF DECEMBER 21, 1876.

On the evening of Dec. 21st, 1876, a very large and remarkable meteor, apparently originating in Kansas, passed over the central belt of the United States, in an easterly direction, and disappeared in Pennsylvania. It was first observed, as far as has been learned, at Hays City, Kansas, passing slowly along at an altitude of about 25 degrees above the horizon, with a downward tendency, so much so that most observers all along its course believed that it reached the earth within a mile or two from them. Reports from Hays City, Lawrence and Fort Scott, Kansas; Kansas City, Jefferson City and St. Louis, Missouri; Keokuk and Burlington, Iowa; Dorchester, Quincy, Jacksonville, Nameoki, Champaign, Galesburg, Lewiston and Chicago, Illinois; Lafayette, Garrett, Indianapolis and Fort Wayne, Indiana; Louisville, Kentucky, Cincinnati, Dayton, Columbus and Cleveland, Ohio, and the northwestern portion of Pennsylvania, show that its course was a

little north of east, and that the time occupied in traveling this great distance of not less than 1,000 miles, was between 8:15 and 9:15 P. M., a velocity equal to nearly 100 miles per minute, after allowing for the earth's motion. Its height was estimated by various scientific observers at something like 160 miles, at its first appearance, and probably about 20 miles at the moment of its disappearance.

At the time of its passage over this city, it seemed to those who saw it about as large as the full moon, with a train from 25 to 100 feet long, of a reddish or orange color and entirely unattended with any noise or sound. As it passed further east it seems to have become broken up in several parts, to have assumed brighter colors, to have thrown off a large amount of luminous scintillation, and to have been accompanied, in some instances, with a rushing or hissing sound and in others with explosions of greater or less violence. At St. Louis the descriptions given by various observers are reported as follows in the *Globe-Democrat:*

"A very remarkable meteor startled the people of this neighborhood last night. Shortly after 8 o'clock a sudden flash of light illuminated the western heavens, and in a few seconds a train of light was observed running along through the misty atmosphere from south to north and northeast. While a *Globe-Democrat* reporter was walking westward on Elm street, between Sixth and Seventh, the illumination of the sky made itself apparent. The atmosphere was exceedingly hazy, and hence probably resulted some of the effect. On the south of the western end of that part of Elm street is situated the high building known as Pope's College, and it was from the southwestern angle of this building that the first flash of the meteoric visitor was perceived. At this time the reporter was standing about half way down towards the eastern end of the block, but the sudden illumination made him run westward towards Seventh street. Arrived at a spot about fifty feet from the western end of the block, the portentous trail of the meteor became apparent, and thence it ran at about an elevation of twenty-two degrees from the horizon, northwardly with a slight deflection to the east, and tending towards the earth till it disappeared behind the high buildings on Market street. Judging from its general course, the probabilities seemed that the meteorolite fell somewhere in Northern Illinois. Meteors, of the ordinary run, are too common at this time of year to require more than a passing comment. But the one in question was evidently playing a star engagement. Its appearance from the standpoint mentioned was somewhat similar to an express train running through a fog, with headlight streaming out its light to the front, and the disjected train of sparks in its trail seeming like an exaggerated representation of the lights from the car windows. Moreover, to keep up the similitude to the train of cars, the speed with which the phenomenon passed over the field of vision was nothing greater than an ordinary train of steam cars. A peculiar effect was visible when the meteor passed just below the moon, when the fierce flame of its light was somewhat dimmed. But from this point northwards it gathered in intensity, and when it reached a point due west from the point of observation, the color of its flames, which heretofore had been a sickly yellow, broke out into a coruscation of violet, crimson and purple, and a low hissing noise, like that resulting from the combustion of nitre, fell on the ear.

"Along the streets in the neighborhood where the reporter stood and ran, the people rushed out and stared in open-mouthed wonder at the por-

tentous visitor, and men ran hither and thither in dread wonder—while women were to be seen lifting up their hands as though in dread of some horrible visitation. The entire passage of the meteor across the horizon occupied about twenty to thirty seconds, and its slow movement enabled a close scrutiny of its changing course and varying colors. Other accounts of the appearance of the phenomenon are appended.

"A gentleman passing on High street, near Clark avenue, at about 8:30 o'clock last evening, was startled by a bright flash reflected from the buildings on the east side of the street, and, on suddenly turning to look about, beheld a meteor of most remarkable brilliancy, which was, at that time, in two parts, at about fifteen degrees above the horizon, curving upwards slightly and moving in a course from the southwest to the northeast. The parts were about equal in size, and reminding one, for the instant, of two very large skyrockets, one traveling directly and closely in the path of the other, leaving a luminous belt behind—not broad, but very bright. As the course curved again toward the north, the two simultaneously separated into innumerable parts, each of which expanded wonderfully into bodies of as great brilliancy as the principal ones, and all traveled forward together, but differing considerably in speed.

Mr. A. S. Aloe, optician, No. 206 North Fourth street, describes the meteor as the most wonderful aerial phenomenon he ever beheld. His point of observation was Fourth street, between Pine and Olive. The time was about 8:30. It appeared in the western horizon, and moved in an eastern direction over the city. It was extremely brilliant, and startled all who were fortunate enough to obtain a view of it. The atmosphere was hazy, and the stars were dimly visible. The strange body appeared like a large ball of fire, with a tail at least a hundred feet in length. The tail was as bright as the body, and both presented the hues of the rainbow, but glowed with a more fiery luster. It was visible about ten seconds, and a further view of it was obstructed by the buildings on the east side of the street. It was a most beautiful and startling spectacle, differing from any meteor the observer has ever seen or read of.

Another gentleman, who came into the *Globe-Democrat* office immediately after the meteor passed, said it was visible for thirty seconds; that when first seen by him it resembled a large globe of ground glass, sailing along from west to east at a moderate rate of speed. When near the zenith it divided into four parts, each part being connected with the others by links of fire, and the whole displaying colors of red, blue, green, yellow, etc. It was the most magnificently beautiful thing of the sort he had ever seen. The atmosphere was hazy, and if the fiery messenger is to be taken as an omen of anything, its appearance at such a time is favorable to Hayes.

A gentleman seated near a front window in the Four Courts had his attention attracted, at 8:25 o'clock, to the passing meteor by the sudden and brilliant lighting of the heavens. The incandescent body described an arc from the southwest to northeast, casting off in its progress a brilliant shower of sparks, which were gathered in a luminous train of the most dazzling colors, the whole constituting an exhibition of pyrotechnics beggaring the descriptive powers. Seemingly the time occupied in passing from horizon to horizon was more than a minute, though under such extraordinary circumstances, the incentive for watching the movements on the face of the heavens was greater than for following the movements on the face of a timekeeper, had there been opportunity for doing the latter. The fiery mass disappeared as it came, cutting its luminous way through the atmosphere, so startling a visitor that few had comprehended its character until it had passed from sight.

XUM

TELEGRAPHIC ACCOUNTS.

JACKSONVILLE, ILL., Dec. 21.—A grand and singularly beautiful meteoric display was witnessed from this city to-night, about 8:30 o'clock. The meteor first came in view away to the west, and about 30° above the horizon. it passed seemingly but a short distance north of the city, and was finally lost to sight away to the eastward. When first seen it seemed a blazing, burning ball, nearly as large as a full moon, and appeared to be moving directly towards this city. As it swept along, with its fiery tail, some twenty degrees in length, and some ten to twenty blazing fragments, it presented a spectacle of surpassing magnificence and beauty. When this great ball of fire reached a point considerably east of north, it burst into some ten or twelve fragments, not unlike in appearance to the bursting of a rocket, and these fragments seemed to finally disappear in a bank of clouds which hung near the eastern horizon. The meteor was of such surpassing brilliancy that the whole earth and heavens were lighted up so brightly that persons could be distinguished at a distance in the streets almost as plainly as in daylight. The light was such that it gave a subdued green coloring to the earth, trees, buildings and every other object. From the time the meteor was first seen in the west till lost sight of in the east full twenty seconds must have passed. A singular feature of the phenomenon was that, instead of passing in its flight earthward, its path from west to east seemed in an exactly horizontal direction. Nothing of the kind of such grandeur, brilliancy and beauty was ever before witnessed here.

NAMEOKI, ILL., Dec. 21.—This evening, at 8:35 p. m., by Chicago time, we beheld a rare phenomenon, in the shape of a three-balled meteor, linked together by a stream or chain of fire, presenting the appearance of a luminous substance of various colors that lighted the heavens with its grandeur. It came from the south west, and traveled on a level with the horizon directly toward the north-east, at a moderate speed, leaving innumerable sparks in its path, and increasing in length as it disappeared.

CHAMPAIGN, ILL., Dec. 21.—A meteor of wonderful brilliancy passed over this place to-night about 9 o'clock, exploding in the north part of the city. Its explosion raised the alarm of fire among a large audience assembled in the basement of the Congregational Church, and temporarily interrupted the speaking. It came from the west, and appeared about the size of an ordinary wash-tub, with a trail nearly 400 feet long, and continually dropped fire.

LAWRENCE, KS., Dec. 21.—A large and brilliant meteor passed from west to east over this city this evening, about 8:15 o'clock, remaining in sight nearly one minute.

LAFAYETTE, IND., December 21.—A very large and brilliant meteor passed over the city about 8:30 o'clock this evening. When first discovered it was a little north of west, and passed out of sight in a northeasterly direction. Persons who saw it describe it as one of the most beautiful ever witnessed. The main body appeared nearly as large as the moon when full, and seemed to be followed by a large number of smaller bodies, like stars, very brilliant and of all colors. It was accompanied by a loud noise—some describe it as a very heavy explosion, followed by a noise as of a heavy train of cars in rapid motion, and by others as of heavy continuous thunder, accompanied by a visible jarring of the ground. It was noticed by parties on the cars coming in from Indianapolis and on the train from Toledo. It is reported as having been seen at Attica, Delphi, Rockfield, Logansport and Earl Park.

XUM

GARRETT, IND., December 21.—The people of this place are considerably perplexed because of a very remarkable phenomenon which occurred this evening about 9 o'clock. There was an explosion in the air almost as loud as a cannon, and much sharper. The heavens became illuminated, and many persons became alarmed and rushed into the streets. There was a rumbling sound after the explosion, which lasted over five minutes.

JACKSONVILLE, ILL., December 22.—The grand and gorgeous meteoric display Thursday night was the topic of interest here to-day. All who had the good fortune to witness the sight concur in the opinion that it was a scene of resplendent beauty and sublimity. An interesting fact, in addition to those telegraphed by your correspondent, is that the passage of the blazing meteor athwart the heavens from southwest to northeast was followed, first by a hissing sound, caused, doubtless, by the cleaving of the air, and then a rumbling sound like distant thunder, supposed to have been caused by a rushing together of the air to fill the vacuum.

KEOKUK, IOWA, December 22.—The meteor which passed over this city last night was the most brilliant ever witnessed here. Its apparent path was downward about forty degrees eastward, and it left behind a train of light embracing all the tints of the solar spectrum blended into an illuminating blue and purple. This train continued visible for more than a minute, assuming a serpentine form in places while drifting into obscurity. The height of the meteor when it passed here is estimated at twenty miles. Soon after the flash a perceptible concussion was felt. At Laharpe, Ill., a distance of about forty miles from here, the detonation resembled the report of a cannon, and it is thought that the final explosion occurred not far from that place. The meteor threw off a large number of fragmentary lights.

BURLINGTON, IOWA, December 22.—A large number of citizens on the street at 9 o'clock this evening witnessed the descent of an immense flaming aerolite, which passed over the city in a direction east of northeast, and probably went into the earth somewhere in Illinois. Its extraordinary size and evident proximity to the earth were remarked, and its light was so brilliant that many aver that newspapers could have been read by it. The train that followed it was many-hued, as though composed of cooling particles of metal. It was seen also at Unionville, Missouri, and at Fort Madison, Iowa.

DORCHESTER, ILL., December 22.—The most wonderful display of a meteoric nature was seen at 8:45 last night. It appeared to rise in the west, and was at its highest elevation about three-fifths of the distance from the northern horizon to the zenith. It appeared as wide as the disc of the sun. The trail was about thirty degrees in length, emitting in appearance sparks and balls of fire. Time in view, about thirty seconds; disappearing about fifteen degrees above the horizon in the northeast.

QUINCY, ILL., December 22.—The brilliant meteor of last night has been the general theme of conversation here to-day.

LOUISVILLE, KY., December 22.—A telegram from Bloomington, Indiana, to the Associated Press agent at Louisville, says Prof. Wylie, of the Indiana University, distinctly saw, for three minutes, the meteor of last evening.

Prof. William Black, of Keokuk, Iowa, remarks: "The brilliant meteoric display of last evening was quite a remarkable event in the history of the science in which the phenomenon is embraced. Ordinary shooting stars are of frequent occurrence. No audible sound proceeds from them, because they are bodies of feeble density, and are generally dissipated or consumed while yet at an altitude of fifty miles above the earth's surface. But the spectacle of a dazzling detonating meteor, as the one of last evening, is quite rare.

"Coming from a cosmical cloud in stellar space, the fire ball appeared in the heavens over Northern Missouri and Southern Iowa at an altitude of about twenty-five degrees above the horizon. The light must have attracted the attention of multitudes of persons as far north as Dubuque, Iowa, and as far south as Memphis, Tenn. From such data as could be obtained, its apparent path was downward about forty degrees eastward, and, owing to the existence of fibrous cirrus clouds in the upper atmosphere, it left behind a train of light embracing all the tints of the solar spectrum, blended into a beautiful blue and purple. From a comparison of numerous reports and statements, it is computed that the height of this meteor at the first instant of apparition, was 160 miles and at the instant of its disappearance probably twenty miles, the length of its visible path being more than 130 miles, which distance was described by the nucleus in about ten seconds, although the train of light which followed continued visible for more than a minute, assuming a serpentine form in places while drifting into obscurity. Soon after the flash quite a perceptible concussion must have been felt about 200 miles in every direction, centering in the vicinity of La Harpe, Ill., at which place the detonation resembled the report of a cannon.

"Before the final explosion, however, quite a large number of fragmentary lights were detached from the main nucleus, by process of the enormous heat. The column of smoke resulting from the combustion must have been a thousand feet in diameter.

"The exact height of the fire-ball at the time of the final explosion and disappearance cannot be accurately determined, but it is evident from the accelerated density of the lower atmosphere, that it was not within twenty miles of the earth's surface. Of 800 detonating meteors found recorded in scientific journals, some attended by almost deafening reports, and much more brilliant than the one last evening, none have descended within twenty miles of the surface of the earth before final combustion. It is not unfrequent, however, after the main explosion, for fragments to reach the earth as aerolites."

As Seen at Chicago.—The meteor which flashed across the country from the southwest to the north east, on Thursday evening, passed south of Chicago; along its southern horizon, in fact. Persons on the streets, at about 9 o'clock, however, noticed the reflection of its light. This diffused light flashed overhead like that from rapid lightning flashes below the horizon on a summer's night. These flashes followed each other in quick succession, and were reflected on the snow for, perhaps, three to five seconds. The light was perfectly white, not so bright or palpable as that reflected from a distant thunder storm, and shimmered like the aurora borealis, which it resembled more than anything else, except that it had no radiating points, no outlines, but was diffused over the entire sky. Before any one had time to get over the surprise and turn to see whence it came, it was gone. It was not known then that a meteor had crossed the heavens, and there were various speculations by the few who saw it as to the cause. One thought that, by some means, all the street lamps had flashed up suddenly, as gas has been observed to do in houses, and that the light was thus reflected from the clouds. Another attributed it to the aurora borealis, and another to some unusual electric condition of the atmosphere, and supported his belief with the statement that a rumbling sound, as of thunder, and a trembling of the earth accompanied it. The writer, who was on Park avenue, near Robey street, at the time, and was brought to a halt by it, did not actually hear any noise, nor feel any trembling of the earth, though he had an impression as to both—as though the ghosts of those two phenomena were present. It may have been that this impression arose from the fact

that these results generally follow the seeing of a flash of lightning. It was natural at the moment to attribute the flash to lightning, whereupon nerve and ear were at once put in readiness to feel the tremble and hear the thunder in confirmation of the evidence given by the eye.

A correspondent of the *Times*, down in Indiana, speaking of the phenomenon, nicely avoids the point of libel by stating that "an alleged earthquake" passed over that section.

GALESBURG, ILL., December 22.—This community was startled, between 8 and 9 o'clock last night, by a large and brilliant meteor passing in a northeasterly direction over the city. Prof. Comstock, of Knox College, gives the following description of it in this evening's *Republican-Register:* My family were startled by a brilliant flash of light which fell upon the carpet in the presence of lamp-light as being green. The children gave the alarm and rushed to the south door, just in time to see the explosion of a splendid meteor. They say it was red, blue, and all colors, like a rocket. The light cast upon the clouds had a greenish tint. I was too late to see anything, though it could not have been more than ten seconds from the time the alarm was given until I was in the open air. However, in about five minutes (estimated, not observed), a tremendous explosion occurred, consisting of two reports, with an interval of about a half-second. Every window in the house seemed to rattle, and the solid earth to tremble. It closely resembled a heavy clap of thunder. If the time between the flash and the report was five minutes, the distance must have been something over sixty miles, and the angle of elevation, as near as can be estimated from the testimony of the observers, would give a height of less than forty miles.

LEWISTON, ILL., December 22.—On Thursday evening at 8:45, a magnificent meteor, apparently as large as a flour barrel, passed nearly directly over this place, from west to a little northeast. It left behind it a luminous trail of fire over 40 degrees in length, and occupied about a full minute in passing across the heavens. The passage of the meteor was followed by a loud report that shook the earth and greatly alarmed the people. Houses trembled violently, and many persons ran outdoors in tremor. After the first report a heavy rumbling sound seemed to pass over from the east to the southwest, and could be heard for five minutes. The meteor lighted up the streets as bright as day. The wonderful phenomenon almost caused a terrible disaster in Beadle's Opera Hall, where a large audience were witnessing a play by a local company. The flash of the meteor lighted up the hall with a sudden glare, and the cry of "fire" was raised. Instantly the audience were in a panic, and hundreds made frantic efforts to get through the doorway. Only the prompt action of a few cool men prevented a rush down the stairway that must have resulted in many women and children being crushed. Order was soon restored, and no one sustained serious injuries.

CHICAGO TRIBUNE EDITORIAL.—The unusually brilliant meteor which passed over the States of Kansas, Missouri, Illinois, Indiana, Ohio and Pennsylvania appears to have followed a path that was very much curved with respect to a plane perpendicular to the earth's surface. Unfortunately, none of the numerous notices of the stranger that have come to hand give its position with sufficient accuracy to permit a calculation to be made of its course. In order, however, to believe that all of them should be approximately correct, it is necessary to assume that the path was several scores of miles above the surface of the earth, and nearly parallel thereto, during the flight over Illinois. This view is supported by the testimony of an observer at Valparaiso, Ind., who heard the noise in from three to four minutes after the flash. Taking 4.6 seconds per mile as the rate at which sound travels

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through the atmosphere, this would give the distance of the meteor from Valparaiso as forty to fifty miles. It appears to have been subject to numerous minor explosions in its visible flight and as its surface became more rapidly heated than the interior by friction in passing through our atmosphere. The Indiana observations indicate that it was almost entirely dissipated into fragments before it ceased to be visible. The last portions probably fell to the earth in New York State; but none of them may be large enough to constitute what we call a "good find." It appears probable that the meteor was less largely composed of iron than is the case with meteorites that are found in large masses, as an earthy consistence is most favorable to such disintegration as is testified to by the majority of observers of the meteor under notice.

INDIANAPOLIS ACCOUNT.—A remarkable meteor was observed in Kansas, Missouri, Indiana, Illinois and Ohio on the 21st inst., which gave forth a brilliant light and exploded with a loud noise, like the sound of a cannon or a heavy clap of thunder. As seen at Indianapolis, it was followed by a train of smaller meteors, estimated at nearly one hundred. Its color changed from yellow to green and crimson. A low, hissing noise was heard when it was directly overhead, and a rumble like a train of cars followed its passage.

According to the best authorities meteors are small planetary bodies, partly disseminated, partly grouped in annular zones, which revolve in elliptical orbits round the sun. When these small planetary bodies come within the sphere of the earth's attraction they obey its influence, and, darting down, give rise to the phenomena of shooting stars and meteoric stones. As these bodies, while obeying the earth's attraction, traverse our atmosphere with planetary velocity they would, no doubt, cause a terrible bombardment, and from their vast numbers render our planet absolutely uninhabitable if their very speed had not been made the means of neutralizing their otherwise disastrous effects: for, raised to incandescence by the atmospheric friction engendered by their enormous velocity of from eighteen to thirty-six miles per second, by far the greater portion of the aerolites are dissipated by heat, and a small number only reaches the surface of the earth in a solid form.

Flammarion accounts for the light displayed in the movement of bolides or solid meteors as being entirely due to the heat produced by the compression of the air, and for their explosions and the falling of aerolites to the earth, by the unequal pressure upon different portions of the body. "Attributing to the bolide a speed of four and one-half miles per second,—by no means an exagerated estimate, M. Haidinger calculates the resisting pressure which it meets with from the air at more than twenty-two atmospheres. Such a pressure evidently tends to crush the body which is exposed to it, and if this body in its more or less irregular shape and constitution offers portions of itself which are more opposed than the others to the action of this pressure, these portions may give way and become suddenly detached from the bolide."

Mr. R. P. Greg, published some years since in the *American Journal of Science* a pamphlet giving an arrangement of meteorites based on their

mineralogical and structural characters, in which he divided them into three classes: aerolites, siderolites and aerosiderites; the first containing little or no iron and the latter two composed largely of that mineral. The intensely magnetic power of meteorites was demonstrated conclusively by the action of one described by Dr. Massena, of Brazil, in 1868. He says, "this aerolite so disturbed the magnetic instruments that the declinometer turned its pole from the north to the west; the horizontal magnometer turned toward the west eight divisions of the scale; the vertical magnometer fell in its center of gravity, and finally the compass oscillated fifteen degrees from east to west."

Numerous analyses have been made of meteoric stones, most of which demonstrate the existence of iron in large proportions, frequently as much as 90 per cent., but as indicated in the classification of Mr. Greg, sometimes very small quantities are present. In such meteorites the mass is found to consist principally of silica and alkalies. Meteoric stones have been found in various parts of the world, some of the largest of which were discovered in Greenland by a scientific expedition from Sweden, in 1870, the largest weighing about 25 tons and having a maximum sectional area of 42 square feet; another weighed 21 tons, others 9 and 10 tons. Another colossal aerolite was brought from Charcas, in Mexico, which weighed 15¼ cwt., and was of the shape of a truncated cone. Smaller ones weighing from a pound or two up to 300 or 400 lbs., are of very common occurrence.

THE BENGAL STORM WAVE.

The disaster which befell the slumbering people of Backergunge, Noakhally and neighboring districts of Eastern Bengal on the night of the 31st of October, 1876, was probably one of the most fearful and terrible in its results that has ever visited any portion of the earth since the Noachian deluge. Without warning, the waters of the Bay of Bengal were suddenly driven upon the land in a single overwhelming wave, from ten to thirty feet high, submerging several outlying inhabited islands, and sweeping inland some five or six miles. The official statement in the Bombay *Gazette* gives the details as follows:

"An official minute by Sir R. Temple, respecting the effects of the cyclone and storm wave, says: 'I visited the islands of Sundeep, Hattia, Shahbuzpore, and the western coast of the river district of Backergunge. In all the localities visited I took the number in each of the villages, and had the precise mortality in each house ascertained in my prescence on the spot, to prevent the possibility of deception. From authentic data thus obtained, I was able to check the local estimates and measure the actual mischief done. Messrs. Reynolds, Beverly, Dr. Weir and the local officials accompanied me. We apprehend that in an area of 3,000 square miles about 1,162,000 persons had been suddenly thrown more or less in danger, of whom 215,000 must have perished. This is only an estimate. The exact number is not known yet, and perhaps never will be. The storm-wave rose

to the height of ten or twenty feet. The Noakhally people think it came from the sea up the Meghna with salt water, and then the cyclone turned it round and rolled the fresh water of the river down; the refluence caused the piling up of the fresh and salt water, which rushed over the surrounding districts; drowned bodies were carried great distances; corpses began to putrefy before the waters retired. The Mahometan population have no cremation, and the masses of corruption of human and animal bodies were frequent, presenting a sickening spectacle. Many corpses were seen at sea; the bodies of living and dead were borne across the arm of the sea from Sundeep to Chittagong, the former clinging to the roofs of their own houses. The force of the inundation appears to have lasted from midnight to two o'clock in the morning. By daybreak there was much subsidence of the flood, and by noon the survivors came down from the trees and regained terra firma. The boats, great and small, which constitute the only means of carriage in these tracts, are all lost. The Noakhally authorities were thus bereft of resources for moving across the floods, and this was a very hard case on the Hattia Islands, where the people were for three days succorless. In the Backergunge District the boats were saved, but much wealth was lost almost entirely, in the form of agricultural crops or cattle. With the exception of Dowlutkhan, a trading town, which was clean destroyed, 8,000 inhabitants, a quarter of the number, perished. On approaching it we steamed for two miles through the creek; the banks were strewn with human bodies.'"

The India correspondent of the London *Telegraph* writes that three waves in succession, varying from ten to twenty feet in height, swept over the doomed district. Many who survived the first shock were overwhelmed in the second or third wave, and drowned before they could reach a place of refuge. The women and children naturally were the most numerous victims, though some were washed into the branches of trees and thereby saved. The trees, indeed, were thickly peopled that dreadful night until daylight broke, and then it was found that not a few had escaped from drowning only to perish of cold. In one tree a man hugging a pig was seen close to a young woman clasping her babe to her bosom. The latter two were alive and unhurt, while the two former were stiffened in death. The long, sharp thorns of the madar tree saved some scores of women by catching their dresses and holding them fast till the wave had passed onward.

The correspondent of the London *Times* writes from Calcutta, November 19th as follows:

"Further details received regarding the cyclone of the 31st of October prove it to have been one of the most terrible calamities on record. Estimates based on official returns from each police section put the loss of life in the districts of Backergunge, Noakhally and Chittagong at not less than 215,000. Probably this figure, enormous as it appears, is still short of the truth. Three large islands—Dakhin Shahabuzpure, Hattia and Sundeep—and numerous small islands were entirely submerged by the storm-wave, and also the mainland for some five or six miles inland. These islands are all situated in or near the estuary of the Meghna, a river formed by the confluence of the Ganges and Brahmapootra Rivers, the largest being Dakhin, Shahabuzpore, in extent 800 square miles, with a population of about 240,000. The population of Hattia and Sundeep together is about 100,000. Up to 11 p. m., on the night of the catastrophe, there were no signs of danger, but before midnight the storm wave swept over the island to a depth in places of twenty feet, surprising the people in their beds.

Happily it is the custom in those districts to plant dense groves of trees, chiefly cocoanut and palm, round the villages. The trees afforded shelter to the villagers, and almost all the survivors saved themselves by climbing among their branches. Some took refuge on the roofs, but the water entering the houses burst off the roofs, and the receding waves carried them out to sea, with the people still clinging to them. A few were carried thus from Sundeep across the channel, ten miles broad, to Chittagong, but the vast majority were never heard of again. The country is perfectly flat, and therefore, trees were the only secure refuge. Almost every one perished who failed in reaching trees. There is scarcely a household in the islands and adjacent coast that has not lost many of its members. The cattle were all drowned. All the boats were swept away, and as wheeled carriages were unknown in those delta districts, the people were thus deprived of means of communication. Almost all the civil officers and police officials in Dakhin Shahabuzpore, except the Deputy Magistrate in charge, perished.

A strange fact about the disaster is that in Dakhin Shahabuzpore and Hattia most of the damage was done by the storm wave from the north sweeping down the Meghna. Several theories have been started to account for this. One is that the cyclone, forming in the bay, struck the shore first near Chittagong, and went north for some distance, and then turned southward again. Another is that the wind blew back the waters of the Meghna, which rebounded with terrific force when the pressure relaxed. A third supposition is that there were two parallel storms, with a center of calm between them. The first or third theory seems most probable, as in Sundeep and Chittagong the destruction came from the south.

The condition of the survivors is better than might have been expected. There was much distress for two or three days, but things are now improving. Backergunge is a great rice-producing district. Its peasantry are the most prosperous in Bengal. Their stores are mostly kept under ground, and have been, of course, thoroughly soaked; but it is believed that they are not seriously damaged. Wherever Sir R. Temple went he saw the people drying their grain in the sun. The cocoanuts will help to give subsistence till the harvest. The growing crops, which were nearly ready for reaping, and which gave splendid promise, have suffered greatly, but will still yield a fair harvest. For some days much disorder prevailed, and robberies were attempted. This state of things was soon rectified. About sixty relief centers have been established. Persons actually destitute will be relieved, but no large sums will be spent. It is believed that all danger of distress will be over after two or three weeks. The district officers are acting with great energy. Sir R. Temple started for the scene of the misfortune immediately the news was received in Calcutta, and he personally visited the suffering districts, going from village to village, and making inquiries regarding the extent of the disaster. He returned to Calcutta on Thursday.

CYCLONES OF OTHER PERIODS.

"One of the earliest cyclones of which details have been recorded occurred not in the usual season, but in December, 1789. It was accompanied by a huge storm wave, which broke on the coast at Coringa, near the mouth of the Godavery. In this case, as in several other cases on record, the coast was swept by three successive waves, the first of which drove all before it, and flooded the town with several feet of water; the second overtopped the first, and covered all the neighboring district, while the third dashed its waters over all. Nearly all the town, with 30,000 inhabitants,

was destroyed, while the shipping at anchor in the bay was thrown far up on to the land. This very spot was visited by an almost equally destructive cyclone wave in 1839. On October 31st, 1831, one hundred and fifty miles of the country at the mouth of the Ganges was swept by a wave which obliterated three hundred native villages and destroyed 10,000 of the inhabitants. Other destructive hurricanes are recorded as having occurred on the same coast on October 7th, 1832, and September 21st, 1839. On October 21st, 1833, a wave swept the mouth of the Hooghly, and overwhelmed 10,000 people; while, on the 21st of the previous May, three successive waves, as at Coringa, swept away six hundred villages and destroyed 50,000 people. The last of these waves was nine feet higher than the highest tide, and the barometer is said to have suddenly fallen as much as two inches.

"In the Calcutta cyclone of October 5, 1864, the devastation was almost solely due to the effect of the cyclone wave, the extent of country laid under water having been 1,500 square miles. It was of little avail that the banks of the Hooghly and its feeders and the island at its mouth were protected by dikes and embankments of from eight to ten feet high; these, even if they had been strong enough to withstand the shock of the wave, were far overtopped by it, and the land inside laid under water to a depth of from six feet to eighteen feet. In the Hooghly the greatest height of this memorable cyclone wave recorded was sixteen and a half feet above high spring-tide level, and about twenty-seven feet above the mean level of the sea. Even as far up as Calcutta it was about the same height as the highest spring-tide, and fourteen and a half feet above mean sea level. The wave was felt as high up as Mehurpore, on the Matabangha. The loss of life directly caused by the storm wave was not less than 50,000, and would probably have been enormously greater had the wave caught the people asleep, as has been the case at Backergunge.

"In the brief space of one month after the Hooghly disaster of 1864, on November 5, a scarcely less destructive wave dashed over the coast at Masulipitam, at the mouth of the Kistnah, where the curve of the coast is precisely of a nature to intercept and concentrate the power of such a wave. The loss of life in this case was something like 35,000 people. Only three years later, November 1, 1867, the Calcutta district had another similar visitation, happily not nearly so destructive, as only 1,000 lives were lost, though 30,000 native huts were swept away.

"Of all recorded previous catastrophes of this kind, the most terrible occurred in 1862, and the natives still remember it as the *banya*, or flood of 1229 B. S. This cyclone appears to have had a very wide range, extending far inland, and to the east, and far beyond Calcutta to the west. It swept over all the islands at the mouth of the Hooghly and over the neighboring coasts. Fortunately the wave broke in the early evening, and, as the cyclone had been raging for some time, the people were in some measure prepared. Still, it is stated, 100,000 of the inhabitants and as many cattle were destroyed, and property to the extent of more than 1,000,000 rupees."

REMARKABLE AURORAL DISPLAY IN COLORADO.

The interesting meteorological occurrence of the 23d ult., consisted in the simultaneous appearance of several parhelia or mock suns, connected with one another by a white horizontal circle or halo, at the same height above the horizon as the sun. The sun was surrounded by two concentric circular coronæ, and an arc of another circle whose centre was in the zenith

touched the outer circle which surrounded the sun. There were traces of other arcs of circles, but none which were very distinct. The primary or inner circle around the sun was at a distance of twenty-two degrees, consequently had a diameter of forty-four degrees. The outer circle was at a distance of forty-five degrees, or had a diameter of ninety degrees.

The circle whose centre was in the zenith had a diameter of thirty-six degrees—eight degrees less than that nearest the sun. This circle, or rather arc of a circle, as also the entire circle next the sun, were very brightly tinted with the prismatic colors; red occupying the centre of the luminous circle, indigo and violet the outer part, shading away by insensible degrees till they were blended with the general color of the sky. The color of the sky inside of the principal circle was an intense dark blue, sometimes beautifully flecked with white clouds, while the space inside the zenith circle was even of a darker blue, and at times almost black, with purplish tinge.

The most satisfactory explanation of this curious but rare phenomenon is to attribute it to the refraction and reflection of light, due to a peculiar state of the atmosphere. When the moisture of the atmosphere congeals into snow or frost, it assumes various crystalline forms. Under certain circumstances the form of these crystals is such that the faces are inclined to each other in an angle of sixty degress. A ray of light passing through a crystal of ice of this form would be refracted from a straight line at an angle of twenty-two degrees. To the eye of an observer, therefore, the halo would appear at a distance from the sun equal to twenty-two degrees. This theory is also an explanation of the order in which the colors occur. The ratio of refraction of the violet ray being greater than the red, the former would occupy the part of the halo farthest from the sun. The secondary halos and parhelia are probably the result partly of reflection and partly of double refraction.

Similar phenomena have been described by Aristotle, Pliny, Scheiner, Descartes and others, the best description being that of Hevelius, as observed by him at Dantzic on the 20th of February, 1661. Parhelia very seldom remain visible more than two hours. That of the 23d inst. was of longer duration than any heretofore recorded, being distinctly visible for over five hours.—*Boulder News.*

In connection with some electric experiments elucidatory of the phenomena of the auroras, PLANTE states that one might conclude that the aurora results from the diffusion in the upper strata of the atmosphere around the magnetic poles of the positive electricity emanating from the polar regions themselves; which emanations may take place either obscurely, when no obstacle is interposed, or may take place visibly, as auroral light, by meeting with aqueous masses either in the solid or liquid state; which matter is vaporized by the heat evolved in the electric discharge, and is subsequently again precipitated either as rain or snow at the surface of the globe.

THE CLOUD BURSTS IN NEVADA.

The San Francisco *Bulletin* says: "Nevada has again been visited with the meteorologic phenomena of cloud-bursts. Heavy rains prevailed all over Nevada, but the cloud-bursts, as two years ago, seem to have been confined to the eastern portion of the State. The recent calamity near Eureka has been the more destructive, and it is a little singular that the phenomenon should have occurred within a few minutes of the same time as that which, two years ago, on the same day of the month, caused such a large destruc-

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tion of property. Meteorology is one of the least understood of all the sciences, but, from the investigations which have been made, there is reason to believe that as more knowledge is obtained it may be reduced to an exact science in the same manner as astronomy. It has, to some extent, been demonstrated that storms, as other natural phenomena, move in cycles of time and place. Scientists will, therefore, be led to the inquiry whether any reasonable conclusion can be deduced from the occurrences on Sunday night and those of two years ago at Eureka. The investigations which were made after the cloud-bursts of 1874 resulted in the theory that these interior water-spouts were caused by clouds heavily charged with rain in a dense state coming in contact with some lofty peak. The fact that they usually occurred in mountainous regions adds weight to this theory. The cloud-burst of Sunday at Eureka, was not, according to the account telegraphed, of such power and force as that occurring in 1874. But the loss of life has been greater this time, although the destruction of property is less. Two years ago the burst caused such a torrent of water to pour through the streets of Eureka as to wash away dwellings and stores. The loss of life is now appalling. Thirteen Chinamen, wood-choppers, and a camp of Italians, at work lumbering, are reported to have been washed away. There was a cloud-burst on Sunday further east than Eureka. This occured nine miles east of Elko. Such a torrent of water rushed down a mountain side that a large landslide was the result, which was precipitated upon a freight train, ditching it. Another also occurred last night on the line of the Central Pacific, between Mill City and Humboldt, in Humboldt county, Nevada, which laid the track of the road under water for several miles. It is more than probable that we shall hear of additional ones in other portions of Nevada, as we did in 1874. One inconvenience to the people of California from these disturbances of nature is that the telegraph wires get out of order, if the poles are not washed away, and communication with the East is temporarily suspended.

AN IMMENSE AEROLITE.—The large number of meteors lately observed in the sky has attracted considerable attention, especially among scientific men, who are of the opinion that the earth is passing through a belt of aerolites. There is some diversity of opinion regarding the nature and origin of these stones, of which it is calculated at least 5,000 fall upon the earth's surface yearly. The theory most widely accepted is that they are bodies of our planetary system that have come near enough to be acted upon by the earth's gravitation, and thus drawn out of their orbits. A great many aerolites have been found, and nearly every scientific institution in the world is possessed of one or more. The largest of which there is any authentic record was found by a Swedish arctic expedition in 1870, on the west coast of Greenland. It weighs twenty-five tons, and is now at the Royal Academy at Stockholm.

An aerolite of probably much greater size was seen last Friday night by a reporter who was belated on the Ocean House road. At about 12:45, he noticed a peculiar light on the sand and sea around him, and upon looking upward discovered what appeared to be an immense ball of fire descending toward the earth. Its course was so rapid that before he had recovered from his astonishment the mass fell into the sea, apparently about half a mile from the shore. A loud, hissing noise, followed by a sharp explosion, accompanied the fall, and so frightened the horse which the reporter was driving that his whole attention for the next five minutes was directed toward the unruly animal, but he noticed that the tail of the meteor,

as it is called, or, more properly, the combustion occasioned by the immense velocity with which the stone traveled through our atmosphere, remained visible for about two minutes. From the brilliancy and area of the fire surrounding the falling stone, and the splash occasioned by its sudden immersion, it is certain that the aerolite must have been of immense size, although, of course, no estimate could be made with any accuracy during the few seconds the aerolite was visible.—*San Francisco Chronicle.*

THE CALIFORNIA EARTHQUAKES.—The San Francisco *Alta* of December 21, says: "Seven distinct earthquake shocks—one of them so severe that, according to the local paper, the 'buildings labored like a ship at sea'—visited the town of Silver Mountain, Alpine County, within half an hour in the early evening of the 11th inst., but did no damage. We have no report yet that these shocks were felt elsewhere. Silver Mountain, which has now, so far as we remember, had its first experience of this kind, is about 6,000 feet above the level of the sea, beyond the summit of the Sierra, 150 miles in a direct line eastward from San Francisco, and 200 miles northward from Owen Lake, which last place, on account of the volcanic character of its geological formation and its severe earthquake of March 26, 1872, has the reputation of being rather shaky. From 1851 to 1868 earthquakes were common in this city—so frequent, indeed, that one observer, who made a lengthy report on them to the San Francisco Academy of Sciences, declared that for a considerable period there was more than one a day on an average—and rare in the mountains; but in the last eight years the coast from Monterey northward has been comparatively exempt, while the region east of the Sierra, from Owen Lake to Virginia City, has had the most notable visitations, though no one place has had many. Italy, Greece, Asia Minor, and California are all classical as earthquake countries; but the last will doubtless be as secure for its inhabitants generally as the others have been for thousands of years."

AGRICULTURE AND HORTICULTURE.

CROPS OF THE COUNTRY.

From the December report of the Department of Agriculture we extract as follows on the crops of the year:

"The returns of November make the corn crop only two per cent. short of the great crop last year, and fully fifty per cent greater than the crop of 1874. The aggregate is 1,295,000,000 bushels. Less than one per cent. of this is raised in New England, scarcely six per cent. in the Middle States, twenty in the Southern, forty-four in the Ohio basin and twenty-nine west of the Mississippi. The South raises 10,000,000 more bushels than last year; New England 300,000 more, and there is less in the Middle and Western States. The Southern States stood twenty-three in 1870 to twenty now. In 1850 the West produced thirty-two per cent, of the crop; in 1860

thirty-two per cent. The states of the Ohio basin, with Michigan and Wisconsin, stood thirty-nine per cent. in 1850, forty-one in 1860, and forty-four in 1870 and 1876. Minnesota, Iowa, Missouri, Kansas and Nebraska produced seven per cent. of the entire crop in 1850, fifteen per cent. in 1860, twenty-one per cent. in 1870, and twenty-eight per cent. in 1876. The increase in Kansas has been very rapid of late, nearly equaling in amount this year the crop of Missouri. Iowa grows more than four-tenths of the crop in this section. Illinois produced about 250,000,000 bushels this year; Iowa, 155,000,000, Ohio, Indiana, Missouri and Kansas rank next, in order named. There has been an aggregate increase in area of production of about 2,000,000 acres.

"The potato crop falls considerably below an average. Drought is given as the principal cause of diminishing yield, though beetles, grasshoppers, blight, rust and rot had especial localities to themselves. There is also a general decline in quality.

"Of other crops, we note that the entire production of hay is eight per cent. above last year, and five per cent. better in quality; beans, about seven per cent. less than last year; buckwheat, eight per cent. less; sorghum, fourteen per cent. above; tobacco, not quite so favorable as last year. The decrease is in Massachusetts, Connecticut, New York, Maryland, Virginia, North Carolina and Tennessee; Pennsylvania, Ohio, Indiana and Illinois report an increase, that of Ohio, Indiana and Illinois being very large. The quality of the entire crop is about as last year.

"In fruit, apples exceed last year's crop in all the states except Maine, Vermont, New Jersey, Delaware, Virginia, Missouri, and in all the Southern States except South Carolina. The only complaint in the other states is superabundance, which diminishes the value greatly. Pears fall below last year, the blight being the principal cause. Grapes, somewhat less than last year, mildew and rot being principal agents in the decrease.

"The acreage of winter wheat put in last fall increased five per cent. over previous year, and the condition appears to be about ten per cent. above average, taking the entire country. The fly has done considerable damage in several counties of Pennsylvania, especially in early sown wheat. With the exception of South Carolina, the South Atlantic and Gulf States are below average in condition. West Virginia and Kentucky, and all the states north of the Ohio River, show a superior condition, especially Ohio and Indiana. In some western localities grasshoppers destroyed first sowing, necessitating a second, which has started very imperfectly. In rye, the average is about with that of last year, and condition an average."

BEE CULTURE.

Prof. Cook sends us an extended report of the bee-keeping experience during the year at the Michigan Agricultural College, the main points of which we summarize. In the spring the apiary grounds were surrounded by numerous honey-producing shrubs and trees, among them bass-wood, locust, crab-apple, shad-bush, &c. Most of these have done well—a few have died. These have been kept mulched, and the ground about them well spaded all the season. More evergreens have also been set out, some for a wind-break, others for shade for bees, and some Concord grapevines and Virginia creeper, for shade. Some of the latter has been set about the house, that it may climb upon it, and has already made a fine growth. Several kinds of bee-plants of more or less repute were also planted, the following of which have done well, and all yielded bloom except the two first, which will not bloom till another season: Yellow trefoil clover, yellow

Bokhara clover, mignonette, black mustard, Chinese mustard, borage, common and silver-leaf buckwheat, common and Chinese sunflower, and Rocky Mountain bee-plant.

The colonies were not permitted to swarm, but artificial swarming or dividing was practiced. Three colonies left without leave-taking, which loss might have been prevented by "previously cropping the queen's wings." The professor says he has proved, what reason and a knowledge of the natural history of the honey-bee would discover, that natural swarming is always suffered at a great sacrifice. This insures a queenless colony for nearly or generally quite two weeks, which is equivalent to the loss of a fair colony of bees, as a good fertile young queen will start a fair colony in this time, especially as this is generally at the time of the best honey season of all the year. The great value of the extractor was again demonstrated during the unusual honey yield of August and September. Although the bees had plenty of room in the supers—both boxes and frames—still they would fill up the brood space as fast as the bees came forth, so as utterly to preclude breeding. By extracting, the brood-chamber was kept replete with brood, while by omitting the same, breeding stopped entirely. It was found, too, that this sent the queen into the supers, where she would lay if there was a possible chance; whereas she remained below entirely when room was given her in the brood-chamber.

The fact that there was no brood reared in colonies destitute of pollen till the bees had gathered and stored some seems to demonstrate that pollen is an essential element of the feed of the larvæ, though it is not required by the mature bees. The rapid increase of brood in the spring would also indicate that it is as well, if not best, that the bees have no pollen till they can fly out in the spring. The observations of the past spring, sustained also by those of 1874, show that bees are pretty apt to be able to gather pollen as soon as it is best for them to fly in spring—by the middle of April—and that feeding meal is unnecessary. Evergreens for shading the colonies, especially Norway spruce, not only serve an excellent purpose, but can be trimmed so as to make the apiary grounds very attractive from their beauty, and are to be strongly recommended. Sawdust about the hives, underlaid with brick, by keeping the grass down, serves an excellent purpose, as it enables one to see at once any bees that fall upon it, and thus insures against loss of queen.

As all the bees wintered so well during the past winter, no special difference could be seen between those fed late the previous fall and those that were not. All bred so late as to vitiate the experiment. The experience of the summer shows that the following honey-plants not only yield well, but that they bloom well early in July till autumn, covering a period when there is a dearth of native honey-bloom: Mignonette, borage, and black mustard. Chinese mustard is inferior to black mustard. It blooms early, and the bloom fades away much sooner. Sun-flowers are unworthy cultivation, while the Rocky Mountain bee-plant blooms too late to be valuable where there is plenty of fall bloom native to the region. With no native bloom to furnish autumn honey, it would be valuable. All of the above do well on light sandy soil. The autumn experienec proved that golden-rod honey, though rather dark, is of very superior flavor. Several good judges have pronounced it superior even to linn or white clover.—*N. Y. Tribune.*

GRAPE PRUNING.—People have been befogged and bewildered by reading grape books and articles on grape culture, so much so that many are fearful to apply the knife or use common sense in pruning. A variety that

may require very heavy pruning on one kind of soil naturally rich or highly manured, may require but little on other soil not so rich or in such good condition. There is no better season for pruning the grape than the present month, and as pruned it is well to lay the canes on the ground and allow them to remain there until spring. For a trellis or arbor, or side of buildings, it is well to allow about two or three leaders to grow, and this month cut back one-third to one-half of past season's growth, if it is desirable to confine their growth within certain limits, but if there is a large space to cover, do not cut back. Cut the side granches that grow out from these leaders back to within a foot of the leader, unless the leader is very strong, and the side branches also, and in that case it may be cut back at half the length to reach the next leader. There can not be a better rule applied to all vines than to trim out any part of the vine that is branching out too freely, and train canes where the space is not sufficiently covered. A little practice is the best school, and common sense the best teacher. If there be trees near by, allow a cane to run into such. Every two or three years allow two or three canes to grow from near the base of vines, and cut out all the old canes, and, having trained all these new canes half way between them, or allowed them to run along near the ground, they can take the place of the old canes as they are cut out. Vines that were set a year ago last spring, and have made a good growth of two or three canes, with small side branches, should have these branches cut back with two or three eyes of the main cane, and the next year allow to grow from these stub side branches wherever needed to fill up vacancies."—*Fruit Recorder.*

SCIENTIFIC MISCELLANY.

SPONTANEOUS COMBUSTION IN COAL CARGOES.

Some years since a royal commission was appointed in Great Britain to inquire into the causes of spontaneous combustion of coal in ships, and into the remedies possible to adopt for providing against such occurrences.

The first efforts of the commission were directed to the collection of information bearing on the general condition of the export coal trade, the methods of shipment employed in different parts of the country, the means of ventilation adopted and the particulars of the casualties that had occurred so far as obtainable.

The results of this inquiry showed an export coal trade increasing from 42,000,000 tons in 1873 to 14,000,000 in 1875; that by far the greatest proportion of casualties occur on long voyages, and that they are most frequent in cases where the largest quantities are shipped in one bulk. The proportion of casualties to quantity varied from one-quarter per cent. of cargoes under 500 tons to nine per cent. in cargoes of over 2,000 tons, and of cargoes destined for California nine casualties occurred out of fifty-four shipments of 500 tons, while out of five ships with cargoes of over 2,000 tons, two were destroyed.

It was also shown, conclusively, that ventilation, instead of being a pro-

tection to such vessels, was a dangerous influence. The Euxine, Oliver Cromwell, Calcutta and Cora were loaded under the tips, at Newcastle, at the same time, with the same coal and from the same seam, sometimes one ship being under the tip and sometimes another. Each carried from 1,500 to 2,000 tons of coal. The first three, which were well ventilated, were bound for Aden, and the last, which was not ventilated at all, for Bombay. The Euxine, Calcutta and Oliver Cromwell were all totally destroyed by spontaneous combustion, while the Cora carried her cargo safely to Bombay. Numerous instances of similar character are reported, and the commission concluded that the pressure recently put upon ship owners and masters to adopt systems of thorough ventilation for coal cargoes increased the risks.

TALKING BY TELEGRAPH.

The newly discovered science of telephony has created much interest among scientific men and electricians lately, and is likely to produce a revolution in the commercial world if the wonderful experiments in talking and singing, now being made between Salem and Boston, prove successful when made under the ordinary conditions of electric telegraphing. The invention is thus described in the *Graphic:*

The telephone consists of a powerful, compound, permanent magnet, to the poles of which are attached ordinary coils of insulated wire. In front of the poles, surrounded by the coils of wire, is placed a diaphragm of iron, while a mouth-piece to concentrate the sound upon this diaphragm substantially completes the arrangement. When the human voice causes the sensitive diaphragm to vibrate, electrical undulations are induced in the coils surrounding the magnets in precisely the same manner as the undulations of the air are produced by the voice. These undulations then travel through the wire, and, passing through the coils of an instrument of similar construction at a longer or shorter distance, as the case may be, are again transformed into air undulations by the diaphragm of the instrument. It will be borne in mind that the voltaic battery is dispensed with entirely, and all that is needed for transmitting the voice sounds are the instruments and the telegraph wire. In this connection a remarkable peculiarity of the telephone is that a practiced ear is able to distinguish the voices that speak through the instrument. The inventor claims that the electric wave of the telephone can be perfected to render free and easy the sounds generated by the human voice to any length.

It is well known that the expense and trouble of batteries and keeping them in order has been one of the main items in the account of telegraphing, and with the present system expert operators are required. Under the system of telephony the cost of constructing the line and putting in the instruments is all, and the affair is permanent so long as the wires and poles shall last.

Respecting the adaptation of the invention to long distances, the late experiments warrant the belief that it can be made to answer all the purposes of the telegraph either under the ocean or across the land. The artificial resistance employed in the experiment between Boston and Salem, as already hinted, was much greater than an equivalent of the length of the wire between New York and San Francisco of the Atlantic cable. In fact, the inventors hope soon to talk through the cable, and send their compliments to Queen Victoria.

XUM

DEFENCE OF SCIENCE IN AMERICA.

In many of the addresses that have been made during the past summer, on the Centennial occasion, the shortcomings of the United States in extending the boundaries of scientific knowledge, especially in the physical and chemical departments, have been set forth. "We must acknowledge with shame our inferiority to other people," says one. "We have done nothing," says another. Well, if all this be true, we ought perhaps look to the condition of our colleges for an explanation. But we must not forget that many of these humiliating accusations are made by persons who are not of authority in the matter; who, because they are ignorant of what has been done, think that nothing has been done. They mistake what is merely a blank in their own information for a blank reality. In their alacrity to depreciate the merit of their own country, a most unpatriotic alacrity, they would have us confess that for the last century we have been living on the reputation of Franklin and his thunder-rod.

Perhaps, then, we may without vanity recall some facts that may relieve us in a measure from the weight of this heavy accusation. We have sent out expeditions of exploration both to the Arctic and Antarctic seas. We have submitted our own coast to an hydrographic and geodesic survey, not excelled in exactness and extent by any similar works elsewhere. In the accomplishment of this we have been compelled to solve many physical problems of the greatest delicacy and highest importance, and we have done it successfully. The measuring-rods with which the three great baselines of Maine, Long Island, Georgia, were determined, and their beautiful mechanical appliances, have exacted the publicly-expressed admiration of some of the greatest European philosophers, and the conduct of that survey their unstinted applause. We have instituted geological surveys of many of our States and much of our Territories, and have been rewarded not merely by manifold local benefits, but also by the higher honor of extending very greatly the boundaries of that noble science. At an enormous annual cost we have maintained a meterological signal system, which I think is not equaled and certainly is not surpassed in the world. Should it be said that selfish interests have been mixed up with some of these undertakings, we may demand whether there was any selfishness in the survey of the Dead Sea? Was there any selfishness in that mission which a citizen of New York sent to equatorial Africa for the finding and relief of Livingstone, any in the astronomical expedition to South America, any in that to the valley of the Amazon? Was there any in the sending out of parties for the observation of the total eclipses of the sun? It was by American astronomers that the true character of his corona was first determined. Was there any in the seven expeditions that were dispatched for observing the transit of Venus? Was it not here that the bi-partition of Bela's comet was first detected, here that the eighth satellite of Saturn was discovered, here that the dusky ring of that planet, which had escaped the penetrating eye of Herschel and all the great European astronomers, was first seen? Was it not by an American telescope that the companion of Sirius, the brightest star in the heavens, was revealed, and the mathematical prediction of the cause of his perturbations verified? Was it not by a Yale College professor that the showers of shooting-stars were first scientifically discussed, on the occasion of the grand American display of that meteoric phenomenon in 1833? Did we not join the investigations respecting terrestrial magnetism instituted by European governments at the suggestion of Humboldt, and contribute our quota to the results obtained? Did not the Congress of the United States vote a money-grant to carry into effect the

invention of the electric telegraph? Does not the published flora of the United States show that something has been done in botany? Have not very important investigations been made here on the induction of magnetism in iron, the effect of magnetic currents on one another, the translation of quantity into intensity, and the converse? Was it not here that the radiations of incandescence were first investigated, the connection of increasing temperature with increasing refrangibility shown, the distribution of light, heat, and chemical activity in the solar spectrum ascertained, and some of the fundamental facts in spectrum analysis developed long before general attention was given to that subject in Europe? Here the first photograph of the moon was taken, here the first of the diffraction spectrums was produced, here the first portraits of the human face were made—an experiment that has given rise to an important industrial art!

Of our own special science, chemistry, it may be affirmed that nowhere are its most advanced ideas, its new conceptions, better understood or more eagerly received. But how useless would it be for me to attempt a description in these few moments of what Prof. Silliman, in the work to which I have already referred, found that he could not include on more than one hundred closely-printed pages, though he proposed merely to give the names of American chemists and the titles of their works! It would be equally useless and indeed an invidious task to offer a selection; but this may be said, that among the more prominent memoirs there are many not inferior to the foremost that the chemical literature of Europe can present. How unsatisfactory, then, is this brief statement I have made of what might be justly claimed for American science! Had it been ten times as long, and far more forcibly offered, it would still have fallen short of completeness. I still should have been open to the accusation of not having done justice to the subject.

Have those who gloat over the shortcomings of American science ever examined the Coast Survey reports, those of the Naval Observatory, the Smithsonian contributions, those of the American Association for the Advancement of Science, the proceedings of the American Academy of Arts and Science, those of the American Philosophical Society, the Lyceum of Natural History, and our leading scientific periodicals? Have they ever looked at the numerous reports published by the authority of Congress on geographical, geological, engineering and other subjects—reports often in imposing quartos magnificently illustrated?—*Prof. J. W. Draper, in Popular Science Monthly.*

THE HELIOTYPE PROCESS.

The principle on which the heliotype process is based was discovered by M. Poitevin, a Frenchman, more than twenty years ago, but the working of it as described by him was not found to be practicable. Various modifications have been suggested from time to time with more or less success. In the heliotype process, beyond the actual principle, every part, step and method, is peculiar to itself, and has been protected by patents in Europe and the United States.

The principle above referred to is, that gelatine, which ordinarily absorbs water very readily, when treated with a bi-chromate and exposed to the action of light loses this property and becomes water-proof to a greater or less degree, according as the action of the light is greater or less. So that by allowing light to act through a photographic negative on a sheet of bi-chromatized gelatine, we can communicate to the gelatine the same property which is given to a lithographic stone, by drawing upon it with greasy

ink; that is to say, where the light has acted, just as where greasy ink has been used, water is repelled; where light has not acted, water is absorbed and grease repelled; and where light has partly acted, as in the half-tones of a negative, water is partly absorbed, and grease partly repelled. This important fact must also be noted, viz: that the gelatine sheet thus treated has capabilities far beyond those of the lithographic stone, the latter being able to deal only with the contrasts of black and white (or *lines*), while the gelatine is able to render all the infinite gradations of shade (or *half-tints*) which appears in any photographic negatives taken from nature or life. Ordinary gelatine is dissolved in warm water, and a sufficient quantity of *bi-chromate of potash* is added to render it sensitive to light, and of alum to make it very hard and durable. This solution is poured on a level plate, previously rubbed over with wax, and is dried by means of heat. As soon as dry, or when required for use, the sheet of gelatine is stripped from the plate, and printed under a photographic negative. When the picture appears sufficiently plainly, the sheet of gelatine is taken from under the negative, and made to adhere to a metal plate. The method of adhesion used is that of atmospheric pressure. The sheet of gelatine and the metal plate are put together under water; as much of the water as possible is got rid off from between the two surfaces; the gelatine absorbs the remainder, so that a vacuum is created, and the picture is thus attached to the plate by the weight of the atmosphere. The superfluous chemicals are soaked out with water, and the plate, with the printing surface of gelatine attached, is placed on an ordinary platen printing-press, and inked up with ordinary ink. In printing, it is necessary occasionally to dampen the plate with water. A mask of paper is used to secure white margins for the prints; and the impression is then pulled, and is ready for issue. Two or more inks are sometimes used in the production of one picture, as it is found that, where the light has acted deeply, a stiff ink is required; but, where it has acted not so deeply,—that is, in the half-tones,—a thinner ink may be used. So that a stiff ink is first used for the shadows, and a thinner ink afterward for the half-tones. In this manner three or four inks may be used in printing one impression. The effect of India or other colored tint is obtained by using, instead of ordinary water for dampening the plate, water with some color in it. The paper absorbs a certain amount of water out of the plate, and with it a certain amount of color. The ordinary rollers are not found to be satisfactory; and a mixture of gelatine, glycerine, and castor oil is used.

By a modification of the process and *from subjects in line*, electrotypes are produced capable of being worked on any printing-press with or without type.

T. A. EDISON, in an article in the *American Chemist*, has the following Laboratory Notes, which are of much interest, and may be found valuable:

"Hard rubber or vulcanite, placed for several weeks in nitrobenzol, becomes soft and pliable like leather, and easily broken.

"The vapor of chloral hydrate is a solvent of cellulose. I have found the corks of bottles containing the crystals eaten away to the depth of a quarter of an inch, the cork being resolved into a black semi-liquid. Certain kinds of tissue paper are partially dissolved in time, if thrown in a bottle containing the crystals.

"A very difficult substance to dissolve is gum copal. I have found that aniline oil dissolves it with great facility.

"Hyposulphite of soda is apparently soluble to a considerable extent in

spirits of turpentine. Large crystals of "hypo" melt down to a liquid after several weeks, and if the bottle be shaken, partially disappear. The turpentine smell nearly disappears.

"The vapors of iodine, in the course of several months, will penetrate deeply into lumps of beeswax.

"If to a solution of bisulphide of carbon there be added twice its bulk of potassic hydrate in sticks, and the bottle be well sealed, the whole will, in two months, become an intense reddish, syrupy liquid, with scarcely any free bisulphide of carbon.

THE curious discovery, says the *Scientific American*, is announced by Prof. P. B. Wilson, of Baltimore, that minutely pulverized silica is taken up in a free state by plants from the soil, and that such silica is assimilated without chemical or other change. The experiment consisted in fertilizing a field of wheat with the infusorial earth found near Richmond, Virginia. The earth, it is well known, consists of shells of microscopic marine insects, known as diatoms, which, under strong magnifying power, reveal many beautiful forms that have been resolved, classified and named. After the wheat was grown, Prof. Wilson treated the straw with nitric acid, subjected the remains to microscopic test, and found therein the same kind of shells or diatoms that are present in the Richmond earth, except that the large-sized shells were absent, showing that only silica particles below a certain degree of fineness can ascend the sap pores of the plant.

THE French have introduced a new substitute for gold. It consists of 100 parts by weight of pure copper, 14 zinc or tin, 6 magnesia, 3.6 sal ammoniac, 1.8 burnt limestone, and 9 cream of tartar. The copper is first melted, then the magnesia, sal-ammoniac, limestone and cream of tartar, in powder, are gradually added separately. The whole is kept stirred for half an hour, the zinc or tin being dropped in piece by piece, the stirring being kept up till they melt. Last of all the crucible is covered and the mass kept in fusion for thirty-five minutes. The scum being removed, the metal is poured into moulds. The alloy is fine-grained, malleable, and takes a high polish. It does not oxidize.

BLUE LAMP CHIMNEYS.—Noted oculists, for instance Gräft, Arlt and Stellwag-Carion, recommend either blue, bluish gray or smoke colored glasses as a protection for weak eyes against the unpleasant effect of red, orange and yellow light. On the same principle, the trying reddish-yellow light of candles, lamps and gas, on normal eyes as well as weak ones, can be pleasantly modified by the use of blue chimneys or globes (or at least of shades for the reflection of the light) colored a light ultramarine blue. A remarkably near approach to a light as agreeable as day light is said to be produced by a petroleum lamp with a round wick and a light-blue chimney of twice the usual length, the latter causing so great a draught that the petroleum burns with a nearly pure white flame.

XUM

EDITORIAL NOTES.

THE science-loving portion of our community have been favored with quite a number of lectures and essays during the past few weeks. Under the auspices of the Academy of Science and other associations we have listened to Professors Broadhead, Mudge, Teed and Tice, as well as to Doctors Fee and Shaw and Judge West.

The organization of the Academy of Science in this city last year has proved a decided stimulus to investigation and research in many directions, and if properly managed and maintained, will accomplish much good in the future. There is no region in the whole country where objects of geological interest abound more, nor, from recent discoveries, where archæological remains are more numerous or of greater interest, and the Academy will furnish a nucleus about which scientific men from every direction will gather for purposes of investigation and comparison. It is an institution which should be aided and fostered by all classes of our citizens as a matter of local pride, if for no other reason. Every one can in the course of the year contribute something to assist in building it up, if it be nothing more than a few fossils, minerals, books, or even a few dollars in money.

THE GEOGRAPHICAL DISTRIBUTION OF ANIMALS, with a study of the relations of living and extinct faunas as elucidating the past changes of the earth's surface. By ALFRED RUSSEL WALLACE. Two vols., with maps and illustrations. New York: Harper & Brothers. 1110 pages. For sale by Matt Foster & Co. $10.00.

The object of this most valuable and interesting work, the only one, as far as we know, that has ever been written on the subject without any attempt to wrest the facts into a shape corroborative of some preconceived hypothesis, can best be shown by quoting the author's own language in his preface: "My object has been to show the important bearing of researches into the natural history of every part of the world upon the study of its past history. An accurate knowledge of any groups of birds or of insects, and of their geographical distribution, may enable us to map out the islands and continents of a former epoch,—the amount of difference that exists between the animals of adjacent districts being closely related to preceding geological changes. By the collection of such minute facts alone can we hope to fill up a great gap in the past history of the earth as revealed by geology, and obtain some indications of the existence of those ancient lands which now lie buried beneath the ocean and have left us nothing but these living records of their former existence."

The book is divided into four parts: First, The Principles and General Phenomena of Distribution; Second, The Distribution of Extinct Animals;

Third, Zoological Geography; Fourth, Geographical Zoology. Each of these is illustrated with maps and engravings, but, as the author remarks, they all belong more immediately to Part three, which is handled rather more popularly than either of the others, and is in fact the summing up or conclusion of the work, and should really be read after Part four.

What is to be admired, perhaps, more than any other feature of the book, taken in comparison with many other scientific works, is the absence of any slighting allusion to the Bible or the views of theological writers. The author in this and in other works has adopted the theory that by slow and gradual development the various species of animals now found on the earth have been produced from those preceding them, but he differs from Darwin in admitting that man's physical and intellectual endowments can only be accounted for by acknowledging a special creative act of the Almighty. No reader, however straight-laced his orthodoxy, need apprehend finding any attempt to draw him away from his faith. He will merely find straightforward statements, based strictly and fairly upon facts discovered by the author himself and other distinguished naturalists, and he will lay the book down after reading it with the conviction that it is the result of careful and laborious research, most skillful and systematic arrangement, and an earnest and honest effort to increase the actual knowledge of the reading public without attempting to influence or bias its judgment.

The mechanical work is most excellent, particularly in the maps and engravings, which equal those of any European publisher.

THE POPULAR SCIENCE MONTHLY. February, 1877. D. Appleton & Co., New York. 128 pages. 50c.

This ably conducted journal has reached nearly to the end of its fifth year, and still maintains its original high character and standing as a connecting medium between the highest branches of exact science and the science of common things. The present number contains popular articles on Astronomy, Chemistry, Education, Geology and Engineering, by the best writers of the age, while the editorial department consists of literary notices of late works and a closing summary of current events of marked interest to all classes of scientific readers. We expect from time to time to avail ourselves of this valuable periodical in making up our monthly "Review of Science and Industry," as we have done in this number.

PROFESSOR TICE'S METEOROLOGICAL ALMANAC FOR THE YEAR 1877, with forecasts based upon astronomical events for every day in the year. Published by the author at St. Louis, Mo. 15c.

We have been favored by the author with a copy of this almanac, and shall publish in each number of the REVIEW a record of the weather during the previous month, side by side with the "indications" of the Signal Service Bureau and the "Forecasts" of the Professor, so that our readers can judge for themselves of the value and accuracy of both sets of observers.

XUM

BOOKS, ETC., RECEIVED.—Historical Sketch of Marietta (Ohio) College; Transactions of Medical and Chirurgical Faculty of Maryland; Report of the Commissioners of Agriculture, Washington, D. C.; Eleventh Annual Report of the State Board of Agriculture of the State of Missouri, 1875; Engineering, London, England.

WEATHER RECORD FOR JANUARY, 1877.

Day.	Prof. Tice's Forecasts.	Signal Service "Indications."	Actual Observations at Kansas City.	7 A. M.	2 P. M.	10 P. M.
1	1st to 3d, *F. b., R. t.	cloudy with snow.	clear A.M. c'oudy & snow'g P.M	19°	23°	16°
2	Clouding weather.	" " "	clear all day, snow in the East	6	16	8
3	Rain and snow storms.	clear and warmer	clear all day, heavy snow in the South.	12	25	28
4	4 to 6 †R. b., L. t., clearing	" " "	cloudy A. M., clear P. M.	17	32	31
5	weather and probably	cldy, rain or snow	cloudy and warmer.	26	30	26
6	very cold.	" " "	" " snowed in night	24	29	31
7	7 to 9 F. b., R t., clouding	colder " "	c'ear, snowed nearly all day.	26	18	6
8	and threatening, with	cold and clear.	clear and very cold. Snowing everywhere	—6	10	6
9	rain or snow.	cloudy and cold.	cloudy and warmer A. M. Snowed P. M.	19	30	29
10	10 to 11, R. b., L. t., clear,	warmer with rain or snow	clear A. M , cloudy P. M.	17	30	26
11	or clearing and cold.	cloudy and colder	cloudy all day, N. wind P. M.	24	28	11
12	12 to 15, F. b., R. t., cloud-	cold and clear.	cloudy and cold all day.	2	5	0
13	ing, threatening weather	cold and cloudy.	cloudy A. M., clear P. M.	1	20	16
14	with heavy rains and	colder and clear.	cloudy A. M., sprinkled P. M.	17	32	29
15	snows.	cloudy with snow.	sleeting; bad weather all around.	32	20	—3
16	16 to 17, R. b., F. t., clear	" " "	clear and cold all day.	—12	5	4
17	and cold.	" " "	clear A. M., cloudy P. M.	6	33	33
18	18 to 20, F. b., R. t., cloudy	colder with snow.	cloudy and threatening.	30	23	12
19	and threatening with	" " "	" snowed A. M., clear P. M	10	27	28
20	rain and snow.	rain and snow.	clear and cold.	7	15	11
21	21 to 22, R. b., F. t., clear	warmer & cloudy.	c'ear and pleasant.	14	36	26
22	and co'd.	" "	cloudy and clear. Very cold all over country	18	19	7
23	23 to 26, F. b., R t., cloudy	cold and clear.	clear. Snowstorms in Cal.	—1	23	22
24	and threatening with	cloudy with snow.	clear all day.	10	23	17
25	heavy rain or snow	cloudy & warmer.	" " thawing.	16	35	26
26	storms.	clear and "	" " "	16	39	29
27	27 to 28, R. b., F. t., clear	" " "	" " "	24	42	35
28	and cold.	cloudy and "	" " rained P. M.	29	49	38
29	29 to 31, F. b., R. t., cloud-	colder with snow.	rained A. M., warm S. wind.	48	47	46
30	ing and threatening with	" " "	c'oudy A. M., rained P. M.	47	48	48
31	rain or snow.	" " "	clear and very warm.	35	53	47

* Falling barometer, Rising temperature; † Rising barometer, falling temperature.

As Prof. Tice's forecasts are intended to cover the entire continent he divides the time into periods of three or four days each, because it requires that length of time "for a storm-centre to pass from west to east across the continent." The Signal Service predictions apply to the Upper Mississippi and Lower Missouri Valleys.